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Roger Harrison's
ELECTRONICS
Monthly

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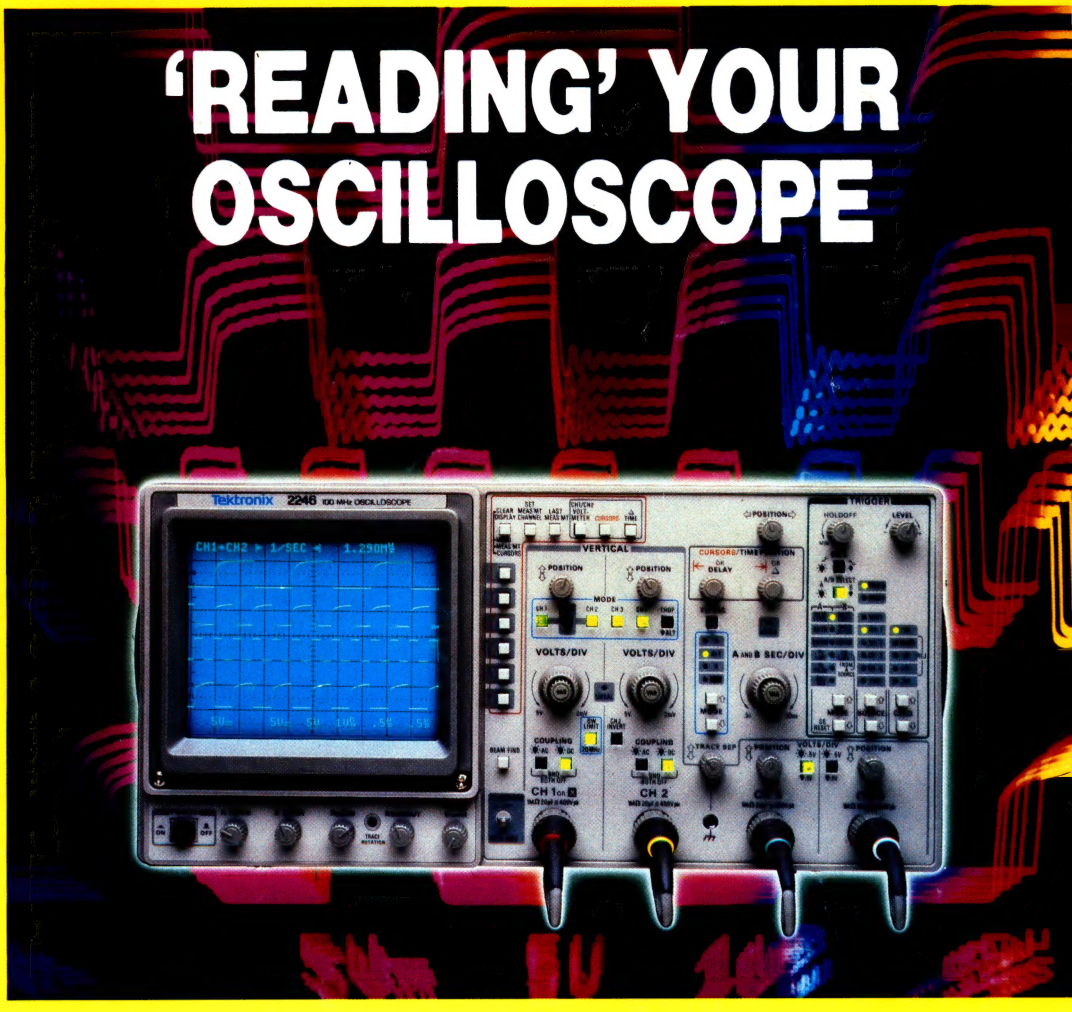
SURROUND SOUND READY OR NOT?

'READING' YOUR OSCILLOSCOPE



ROJECTS:

TEREO
ONTROL
REAMP

GHT-OPERATED
ELAY

MATEUR
OLOUR TV Tx

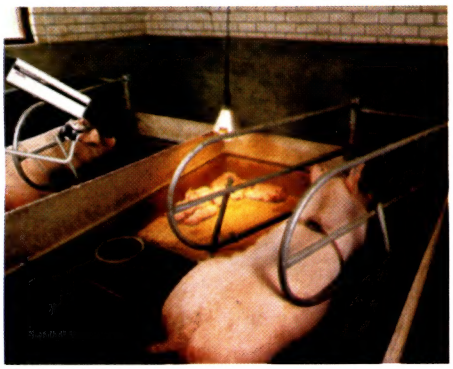
LAST CHANCE AT 7 GREAT BIRTHDAY PRIZES

D.I.Y. FREQUENCY PREDICTIONS

REVIEW: CCTV OBSERVATION SYSTEM

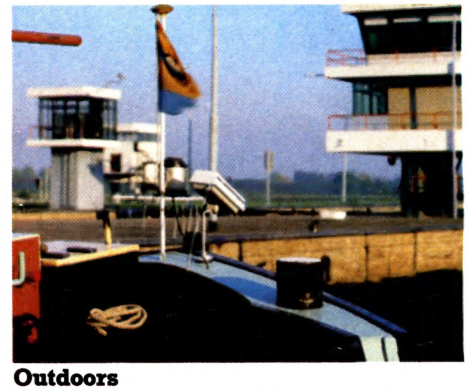
projects • electronics • audio • video • communications • computing • technology

THE COMPLETE OBSERVATION SYSTEM...



Animal Pens

Business or Home



Outdoors

FOR EVERY SITUATION

The Philips Observation System comprises a camera, a black-and-white monitor, and all the equipment and fittings needed for rapid installation.

The basic system comprises: camera, 12-inch (31 cm) black-and-white monitor, mounting brackets with plugs and screws, and 10 metres of coaxial connecting cable.

As well as offering simple installation, the Philips Observation System is easy to operate. Almost every adjustment is taken care of automatically, ensuring an optimum picture at all times.

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The microphone built into the camera picks up sound from the area under observation. This can alert the operator to unusual events, even when full attention is not being paid to the picture.

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Convenient positioning is provided by adjustable mounting brackets.

Extra 'slave' monitors can simply be added.

It is even possible to attach a video cassette recorder to this system.

The system is low in cost and ideal for installation anywhere observation may be needed: around the home, in business, in research, in education — every situation your imagination can dream up!

☐ **Please rush me more details on the Philips Observation System.**

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Tel:.....

Send coupon to:

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or phone (02)925-3367.

PHILIPS

PHILIPS

WELL, THANK YOU readers one and all for your very encouraging and flattering remarks on our recent make-over of the magazine with the July issue. All your phone calls and letters have been most appreciated.

For the constructors among you, we have some exciting projects coming up. In fact, we have a series of prototypes *in hand* that will be published over issues from now until *the middle of next year!*

Apart from the Colour TV Transmitter for amateurs commencing in this issue, we have further practical, useful amateur radio projects coming. For those who like to tinker with radio control models (or who have family members who do), we have a special fast NiCad charger coming that not only gives your batteries the required boost, but prevents them overheating, too. If you're keeping an old car on the road, we've got useful, low-cost projects for you, too. And for those who like to experiment with something a little different — we're still full of surprises!

That's enough for the time being — don't want to give too much away too soon! Over the past three years or so, we've brought you quite a number of innovative project designs, ranging from simple low-cost projects to 'major works' — like the extraordinarily popular Listening Post FAX/RTTY/Morse decoder, the Super Simple Modem, the 6000-series Ultra-Fidelity hi-fi projects, the Weather Satellite Receiver, the Supercomputer and Superbis modem. In fact, I can safely say we've changed the direction of, *and* introduced new interests to, Australian and New Zealand enthusiasts. And we're proud of it! We aim to keep that up.

Roger Harrison
Editor

OCTOBER 31 IS YOUR LAST CHANCE TO ENTER
OUR THIRD BIRTHDAY CONTEST SERIES
WITH SEVEN GREAT PRIZES TO WIN!

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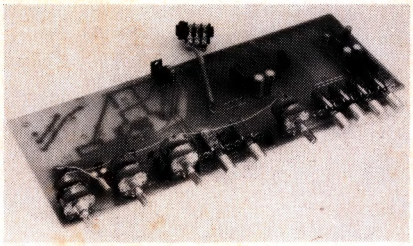

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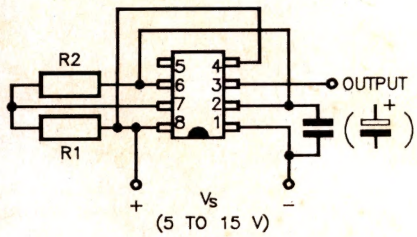

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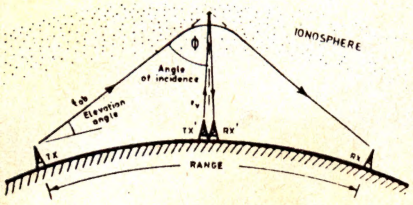
COMMUNICATIONS



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THE "LITTLE BLOCK" 20 W POWER AMP MODULE
Ah, that it would have been so simple in years past! This project is a 20 watt output amplifier module employing a nifty little 5-pin "block" power amp IC. One chip, five resistors, two capacitors and a 35 x 30 mm pc board!

INTRODUCTION TO MICROPROCESSOR EQUIPMENT SERVICING
Here's how to overcome your fears of the "dreaded micro", find ways through the myths and mysteries, clear the fog of confusion and learn something practical at the same time! You don't need mountains of money, tons of time or quintessential qualifications — just an interest in electronics and a modicum of common sense. They're simpler than you think!

BALANCED LINES, INDECENT CONNECTIONS AND LAYING YOUR CABLE
Our PA Series returns with a basic look at why balanced mics are used, a look at connector connection standards and cable laying practices.

While these articles are currently being prepared for publication, unforeseen circumstances may affect the final contents of the issue.

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COVER
Drivers' guide to the oscilloscope front panel and what the display tells you.

Telecom gives subscribers the fibre runs

Your phone calls may be arriving and leaving your home by fibre optics if you live at one of 200 homes in Toorak, Melbourne and Centennial Park, Sydney.

Telecom's Optical Fibre Residential Pilot trial project to these homes is using fibre cable mostly supplied by Australian manufacturer, Olex Cables.

The cable includes single mode 50-fibre cable from the local Telecom exchanges, branching along streets and tapering to a two-fibre cable going into each house.

Olex said the first phase of the pilot project would provide subscribers with enhanced telephone and data capabilities, including: "easy call" memory redial; PABX features; data transmission including 2400 bps; PC interface; AUSTPAC services, for high speed modems; and access to public and private videotext networks.

Phase two of the pilot project provided a trial for multi-channel video transmission when it began last month.

The Principal engineer for the Telecom Metropolitan Customer Access Network, Symon Rozenthal, said the trial would evaluate methods, equipment, practices and standards of installing optical cable and associated equipment in homes.

"Telecom Australia is at the forefront of the development of this technology," he said.

"The pilot program was an important engineering trial and we're confident that we can learn a lot from the experience."

Fibre optics offered the great benefit of being immune to lighting and had a great bandwidth capability for future services, and could be reticulated through existing ducting.

The pilot programme involved developing exchange and customer equipment, new splicing techniques and joint closures.

Olex Cables' technical sales manager Frank Halim said the two-fibre cable which was installed in each house was specifically developed to meet Telecom's strict requirements.

"The single mode fibres have a core of 10 micron, laid up into a grooved slotted core with a Kevlar rod central strength member," he said.

"It is filled with waterproof jelly and sheathed in a black polyethylene jacket to meet TELA 484INS102 standards."

Faggin awarded Marconi Fellowship

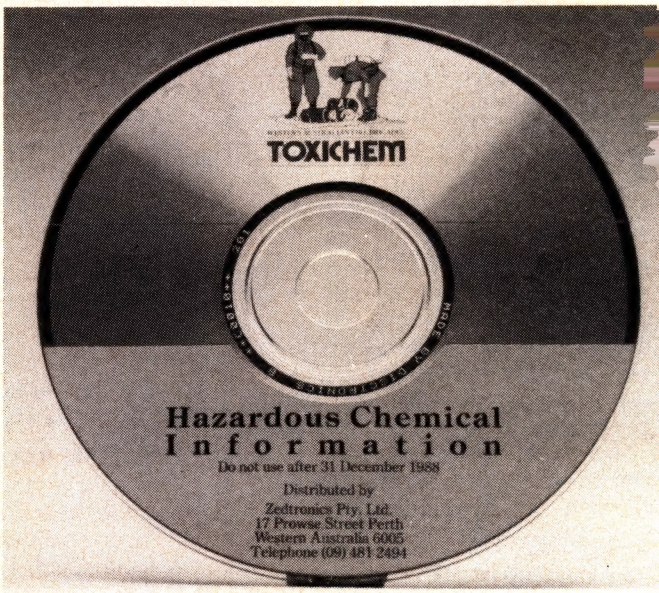
Microcompter pioneer Dr Federico Faggin, a key figure in developing current electronic technology, has been awarded the 14th Marconi International Award.

Dr Faggin, who is the president of Synaptics, was cited for his work in creating and implementing the microprocessor and his extensive contributions to MOS silicon gate technology.

It was his work in developing the first microprocessor, the 4004, that became the key to modern electronics. Under his supervision at Intel during its first five years, the MCS-4 was brought to market; the first 8-bit microprocessor, the 8008, was developed; and the 8080 chip became the first microprocessor to break the performance barrier.

At Zilog, which he founded in 1975, Dr Faggin conceived and developed the specifications for the Z80 and directed its development.

The Marconi Fellowship Award was founded in 1974 to commemorate the centenary of Guglielmo Marconi's birth. The Fellowship is awarded for scientific achievements by researchers motivated similarly to Marconi's commitment that technological innovation should be used to improve the human condition.



Lifesaver CD

Don't reach for a lifebelt or a lifeguard in an emergency: the latest lifesaver, hi-tech Australian style, is a compact disc player that you should clutch at.

The emergency CD-ROM's promotion sounds like a commercial for a cookbook, but the disc has more information than a printed book and less weight to drag you down.

It features lifesaving information designed to give emergency services instant information to cope with spills of any one of more than 30 000 toxic chemicals stored around Australia.

Carrying information equivalent to 250 000 typed A4 pages or 1 500 floppy discs, the lifesaver CD-ROM is called Toxichem and was the brainchild of Western Australian software company Zedtronics.

It developed the disc using a data base developed by the WA Fire Brigade. Disctronics, the only Australian CD maker, produces the CDs.

During a chemical spill emergency services would feed information into a portable persona

MORE USES FOR PHONE LINES

Better use of off-peak electricity, to the advantage of customers and supply authorities, and remote meter reading may be some of the results of a pilot energy management system project.

Running in a south eastern suburb in Melbourne, the project hinges on using the phone lines to 100 customers' homes.

It is being run by Alcatel-STC in conjunction with Telecom, and has equipped the sample homes with Alcatel-STC's Australian-designed and made energy management terminal (EMT).

The total service includes computer controlled network management equipment at a regional centre, and links to the EMT at each of the homes, using a standard existing phone line.

Constant communication between the central controller and the EMTs is achieved without disturbing the normal phone functions of the line.

The two main features are remote meter reading, which saves on costs, and vastly improved remote load control.

Instead of the old electro-mechanical time switches which rigidly controlled when off-peak electricity was provided, the new system has the potential of innovative controls.

Thus, off-peak rates could be switched in as electricity demand fell, to the customers' and supply authorities' advantages.

omputer, or radio information ack to a central base.

Virtually instant reply would upply information to identify he chemical and specify comlete operational fire and accilent response procedures. This vould include level of evacuation required; protective clothng requirements; first aid reponse and environmental implications.

Prospective users would include major emergency services, nd local, state and federal auhorities such as health, agriculure, defence, transport, railvays, environmental protection, uarantine, shipping, customs, olice as well as unions, mining, ransport and chemical companes.

ll at sea with IDD

Direct dialling to ships at sea is OTC's latest gift to Australian telephone subscribers, using its international satellite telecommunications.

Gone are the old style manual connections through Telecom's lomestic network to OTC's window on the world's international naritime system. The manual atching used to be needed because Telecom could not meter hore-to-ship calls at the appropriate rate.

Now the exchanges have been nodified calls can ring the ship's ell of any vessel with a tandard-A satellite Earth tation.

The dial-a-sailor system uses nmarsat, the 54 nation International Satellite organisation. alls to some 7000 ships at sea an be put through by dialling ie International Direct Dial DD) code 0011 followed by the ppropriate ocean code and hip's Inmarsat telephone numer.

For the Atlantic region the cean code is 871; for the Pacific is 872 and for the Indian Ocean gion it is 873.

ibre optic link for TC satellite facility

ibre optic technology has given higher quality, greater exibility and lower cost access the Intelsat Pacific Ocean reon satellites through OTC's ew Sydney Satellite Earth ation.

The new station, which was ened last year, has achieved ese advantages over the facilies previously available through TC's Moree installation.

The new Earth station is in a lley at Oxford Falls and linked the Sydney Gateway by both re optic cable and a microave link.

OTC installed two 12-fibre 50/125 micron multimode cables to connect the Earth station to the microwave terminal. The terminal is on a nearby hilltop, 650 m away from the Earth station.

The designer and maker, Integral Fibre Systems (IFS), supplied the optical transmission equipment to interconnect the analogue TV and 960 channel telephone microwave system with the Earth station.

The fibre optic equipment operates at the 70 MHz intermediate frequency (IF), avoiding the expense and signal distortion involved in modulating and demodulating the IF if baseband video transmission equipment were to be used.

This gives: enhanced picture quality; trouble-free transmission of multiple video standards; and eliminates problems associated with lightning strikes on the microwave tower being transmitted down a metallic coaxial cable to the Earth station.

Subsequently, IFS won a contract to supply fibre optic cable and equipment for OTC's Perth Satellite Facility.

IFS said it saw applications for its 70 MHz satellite links in achieving space diversity operation of Earth stations in the high rainfall areas of northern Australia.

The equipment is also being considered for Singapore's Satellite Education System to provide 70 MHz IF transmission between the studio site and the Earth station. This would allow the video exciter to be at the studio instead of the Earth station.

IRH promotions

Newly appointed, Denis Lamb has gone from general manager of IRH Components to managing director. Consequently Bob Roughton, becoming product manager, among other responsibilities takes over IRH marketing in New Zealand from Mr Lamb.

Mr Roughton, formerly manager of Bell-IRH (NZ), and based in Auckland, will also be responsible for Micron Memory products, IIIV Opto products, and Theta J. Corp. solid state relays and switches.

Hide-away radar

Like a spotlight *you* can see with, but nobody else can see: that's a new naval radar which its developers say is virtually impossible to detect because of its low radiated power.

Based on research from the UK Philips Research Laboratories, the radar operates on the principle of a frequency modulated continuous wave (FMCW) transmission, instead of the pulse power of conventional radar.

The FMCW system radiates just a few watts, making it detectable only at ranges of less than a few miles, contrasting with the easily-detectable thousands of peak power watts of conventional radar.

Developers Hollandse Signaalapparaten (SIGNAAL) in Holland and Philips Electronikindustrier (PEAB) in Sweden have code named the new radar PILOT (Philips Indetectable Low Output Transceiver).

They see it a technological breakthrough because all military radar had been limited in scope previously as its pulsed transmissions could be detected far beyond the range of its own effective operation.

Where ships needed to keep radar silence to avoid detection they lost a necessary navigation and surveillance instrument.

The TC-L3A Minivision will brighten your boring summer days with Panasonic's contribution to portable entertainment, this tiny colour TV, being launched in Australia now. The TC-L3A is a VHF/UHF pocket-portable TV featuring a 75 mm screen, with internal backlight and pop-up display panel which can be viewed at 80° horizontal and 60° vertical for all light conditions.

Panasonic said it had overcome the technical problems which previously led to poor picture quality in LCD CTVs with a product comparable with a CRT CTV; rrp is $699.

The Minivision can use rechargeable batteries, alkaline cells, 12 V from a car or 240 Vac via the supplied adapter. It has an audio/video jack for use with a camera or VCR. Victoria Nicholls is optional.

CD-ROM 'architecture' extended

Extended Architecture (XA): not a bigger and better Sydney Opera House but extended CD-ROM that Philips and Sony have agreed to with Microsoft.

"This extended format will incorporate audio and graphics technology from the CD-I format and will serve as a bridge between CD-ROM and CD-I," Philips said. The CD-ROM was originally designed for an open system to store data.

NOTICEBOARD

This special page is for the benefit of readers, to help you make better use of your magazine.

Please check this page **every month** as notices **will** be changed often.

GOT OUR RIGHT ADDRESS?

Most important! It has become obvious to us that a lot of readers are still addressing mail to our old addresses (there are three variations) so will you make sure that you have our new address, phone and fax numbers?

AEM
1st Floor, 347 Darling Street,
BALMAIN 2041 NSW.
Ph. (02)555 1677. Fax: (02)555 1440

Back Issues

If you are looking for a particular back issue, it's simple, just write to us: **AEM, 1st Floor, 347 Darling Street, Balmain 2041 NSW** and state which issue(s) you need, enclosing a cheque or money order for $4 for each back issue.

It is wise to state which particular article or project interests you in the issue(s) you have specified, because if we don't have the issue in stock, we can send you a photostat of your specified article or project. We are unable to process back issues by credit card, unfortunately, unless the order is above $10.

MAGAZINES WITHDRAWN FROM SALE

Commencing with the July issue, and until further notice, copies of AEM will no longer be available through Jaycar stores, having been withdrawn by the publisher. We apologise to readers who may be inconvenienced by this.

The magazine will still be normally available through newsagents, of course, and other electronics stores; Dick Smith Electronics in all states and New Zealand; in Adelaide, Eagle Electronics and Force Electronics; in Melbourne, All Electronic Components, Preston Electronics, Ritronics and Stewart Electronic Components; in Sydney, David Reid Electronics and Hi-Com Unitronics.

WHERE DO YOU GET IT?

Where do you buy the parts and PCBs for the projects? Every issue has a column called "Retail Roundup", in which you will find the "Project Buyers Guide", usually in a box on the page. This provides a guide to where you might buy your needs for the projects featured in that particular issue.

PROJECT LEVELS

In general, with our projects we include a panel indicating the "level" required for successful construction. This is included only as a guide, the three levels we show being: "beginners",."intermediate" or

LEVEL: We rate this construction project as suitable for:

EXPERIENCED

constructors who have successfully assembled a variety of projects of differing complexities.

Special Offers

We pride ourselves in making available to you special opportunities to purchase interesting products at a special price.

Mostly, we act as a clearing house for orders and have to contend with the usual SNAFU's. Fortunately, they're not too prevalent. If you have a problem with an order, kindly write or call and give us your full name address and ordering details, and most important your phone number. We'll do our level best to sort it out and inform you.

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Please, only after 4.30 pm EAST.

If you were a fly on the wall in our office you would notice that the people who answer these enquiries do not sit all day with baited breath awaiting your call. In actual fact they are crucial members of our team and are expected to do 'some' other work during 'normal' business hours. So please, while we are happy to answer your technical enquiries we also have a magazine to get out. After all, isn't that how you found us in the first place?

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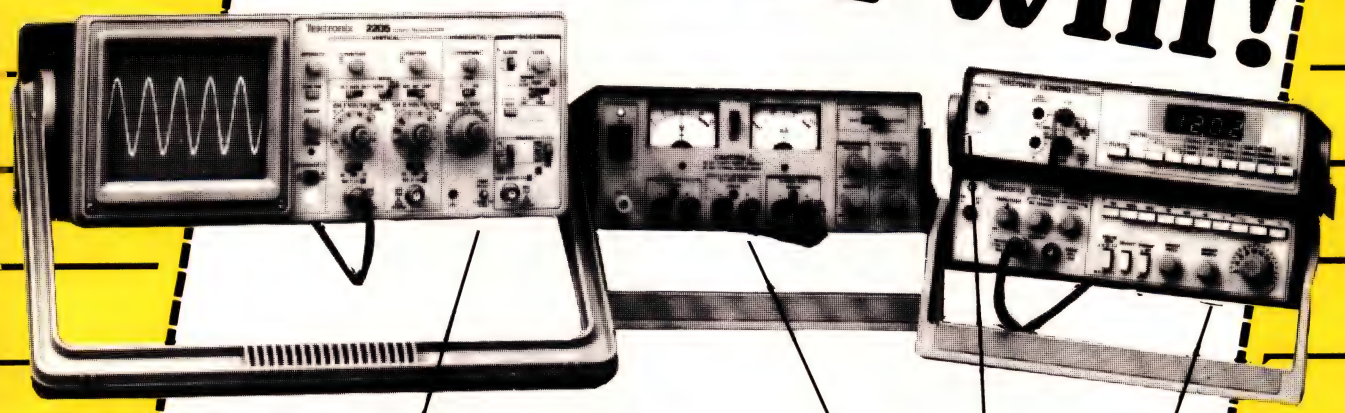

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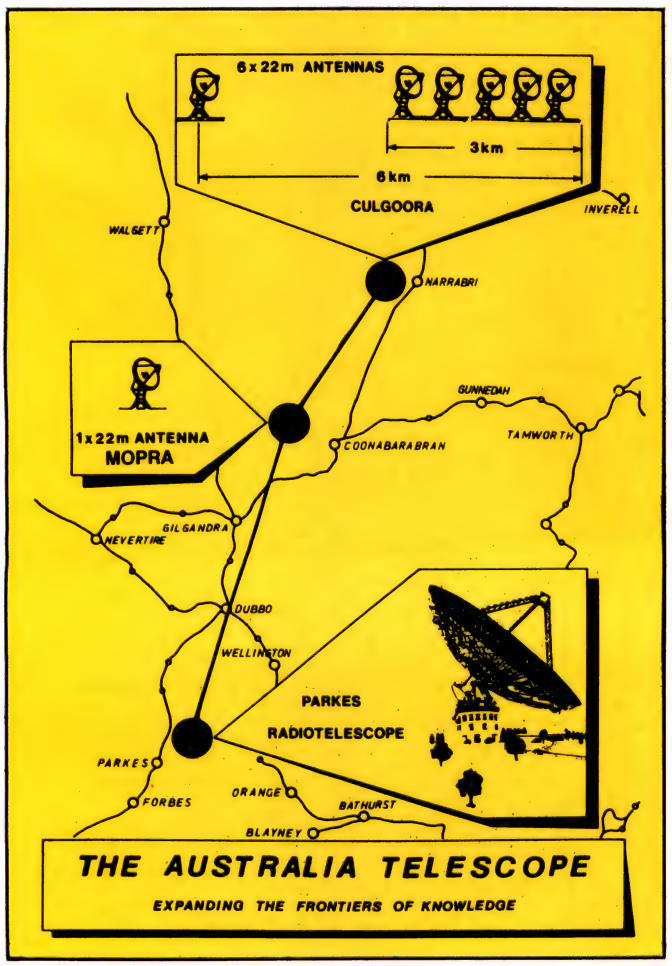
Australian Electronics Monthly is published by Kedhorn Holdings P/L, 1st Floor, 347 Darling St, Balmain 2041 NSW

Australia moves to the fore in radio astronomy again

Roger Harrison
Adam Searle

The opening of the Australia Telescope by the Prime Minister on 2nd September was a significant event for the local scientific and engineering communities. A major aspect of the project was the spin-off to Australian industry. In part, the design strategy was to optimise Australian content.

THE CSIRO's new Australia Telescope will usher in a "new era" of astronomy in Australia, we're told. It is an array of eight separate antennas. Six, all 22 m diameter dishes known as "the Compact Array," are located at the CSIRO's old solar spectraheliograph site at Culgoora in north-western New South Wales. One dish is fixed and the other five are mounted on a linear railway track 3 km long so they can be repositioned, as required, to build up a radio "image" of a celestial object being viewed. The end-to-end width of the Compact Array is 6 km



Another 22 m antenna is located at Mopra in the Warrumbungle Ranges west of Coonabarabran to the south of Culgoora. This is situated near the Siding Springs optical observatory sit supporting the Anglo-Australian Telescope and the Australian designed and developed Advanced Technology Telescope. The Culgoora array and the dish at Mopra are linked with the long established 64 m radio telescope dish at Parkes, forming the Australia Telescope, which title generally gets shortened to "AT".

Why use such an assembly of dishes? The larger an antenna is, the more detail it can "see". However, it is not possible to build a single dish large enough to give the high resolution images which astronomers demand: only a linked group of antennas can do this. Hence the AT.

The Australia Telescope is the only instrument of its kind in the southern hemisphere, and one of the best radio telescopes in the world. It has been designed to be an advanced tool for astronomers of the 1990s and beyond.

The AT has high dynamic range (it can pick up areas of weak emission which lie next to bright areas) and a wide field of view. It has a wide spectral range of 300 MHz to 115 GHz, and with its high angular resolution and sensitivity astronomers will be able to get radio images of southern hemisphere objects containing unprecedented detail.

From all accounts, it will be the only radio telescope with this resolution, sensitivity and diversity in the southern hemisphere for the foreseeable future. So at only $50 million, many consider it to be a bargain.

Making one from many

Using a technique called "aperture synthesis", the AT combines the signals of the eight antennas at the three sites in NSW to effectively create one giant receiving dish.

By combining the signals from pairs of antennas spread across the earth, a very large telescope can be simulated. The longest separation obtainable between suitable dishes in Australia is from the AT dishes at Culgoora to the University of Tas-

Our thanks to Dr R. F. Haynes of the CSIRO Division of Radiophysics, to Intergraph Corporation and Fibrenet for supplying material and illustrations used to assemble this feature.

ere you can see three of the five closely-spaced 22 m dishes of ıe Compact Array at Culgoora in north-west NSW. They all sit on a km-long linear rail track and may be positioned at any of 37 sites r "stations" along it. Another 22 m dish is 3 km away from the end the rail line, making an array 6 km across. At the smallest avelength (3 cm) it achieves a resolution of 0.8 seconds of arc, ›out the same as local optical telescopes under good observing ›nditions. (CSIRO picture by J. Masterson).

ıania dish near Hobart, a distance of 1400 km. This technique ın be extended much further. A decade ago the 64 metre dish Tidbinbilla was linked to a 22 metre dish in the Crimea and to 300 metre dish in California.

In the following decade, the AT will be linked with other ex-ing telescopes in Australia and overseas, and even to a satel-e telescope in orbit to create an "eye" tens of thousands of lometres in diameter.

This has already been done in 1986. An orbiting spacecraft d ground-based telescopes at Tidbinbilla and at Usuda in Ja-n were linked to make observations of quasars. The separ-on achieved was 2.2 Earth diameters — equivalent to a tele-›pe 28 000 km across.

These systems of connected telescopes are called *Very Long seline Interferometry* or VLBI. Simultaneous observations are ıde with widely separated telescopes and each observation is :orded on tape at each constituent site. The signals are then mbined at a processing station, creating a single "message" as rom a single huge telescope, and analysed. The resolution of BI radio telescopes are up to 10 000 times better than con-ıtional optical telescopes on Earth.

A new space VLBI network called the RadioAstron, to be nched in 1992, will synthesise a telescope five times the di-eter of the earth. It is a Soviet space agency project with par-pation from the USA, Japan, Canada, a number of European ntries and the Australia Telescope.

Using the 70 metre diameter Soviet antennas at Evpatoria (in Crimea), Uzbekistan and Ussuriysk (near Vladivostok) dioAstron will combine its signals with those from objects in the northern sky picked up by these dishes. Because observations of objects in the southern sky require the use of ground-based telescopes in the southern hemisphere, Australia is in a unique position to support this important international project. For nowhere else in the southern hemisphere is there a network of large dishes like those of the AT.

VLBI will be useful in studying continental drift by measuring accurately long distances on earth, and in guiding craft deep in space. And for objects near the celestial equator, the combination of RadioAstron with dishes in the Soviet Union, Australia, Japan, America and Europe, will lead to higher sensitivity and better image quality which is so important to scientific research in this field.

Getting to the heart of the matter

The AT will be used to examine things such as quasars, active galaxies such as Centaurus A, the dust and gas between the stars, pulsars, masers and supernovae — exploding stars. These last are very rare. Only five have occurred in our galaxy in the past millenium.

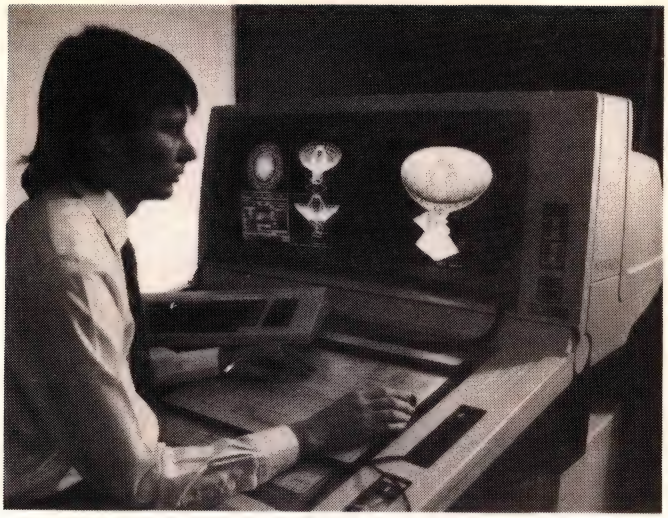
The first supernova seen with the naked eye since 1885 was one in 1987 in our neighbouring galaxy, the Large Magellanic Cloud, 170 000 light years away.

Supernovae are dying stars. They have power equivalent to 10 billion billion billion hydrogen bombs. Once they have exploded in a supernova, all that remains is the compressed core, a neutron star. So dense is this material that a pinhead of matter would weigh a million tonnes!

We are approximately 30 000 light years away from the centre of our galaxy, which optical telescopes cannot see because of a fine dust which heavily obscures it. The AT, it is hoped, will be able to identify the energy source at the centre of the galaxy, believed to be a black hole.

Newborn stars are hidden by dust and gas, but radio observations should be picked up by the AT and enable us to isolate and observe new star-forming regions.

Closer at hand, the relative positions and motions of water ▷



Computer aided design (CAD) facilities were used to design the dishes using a CSIRO-developed system. Local firm Intergraph Corporation supplied the equipment to consulting engineers Macdonald Wagner who did the design.

vapour masers in star-forming regions in our galaxy and other galaxies can help define the fundamental distance scale of the Universe. Its size is directly linked to its age, because of the expansion of the Universe.

Dr John Whiteoak, a radioastronomer at the CSIRO's Department of Radiophysics, has said we can now compete on more than equal terms with overseas astronomers. "Telescopes in the northern hemisphere cannot reach certain phenomena in the southern skies.

"In the southern hemisphere, we can see the Earth's two closest galaxies. The southern skies also contain the Milky Way and the inner regions of our galaxies — and they are the most exciting."

Specialised receivers — the AT's 'ears'

The instrument will be looking at the radio noise from features in space on four frequency bands near 1500 MHz (1.5 GHz), 2.7, 5 and 10 GHz. This provides "viewing" at approximately octave intervals and includes the narrowband signals emitted by certain atoms and molecules in interstellar space which are an important aspect of astronomical research.

The signals gathered by the dishes are first received by specially-designed wideband feedhorns developed at the CSIRO's Division of Radiophysics. These innovative feedhorns allow simultaneous operation on two widely separated bands with different polarisations. A "polariser" located behind each feed splits the received signal first into orthogonal (at right angles to each other) linearly-polarised components, then divides it into two frequency bands.

The lower frequency feedhorns are quite large — 1 m wide at the mouth and 2 m long. To minimise both weight and cost, they were constructed by assembling bands and rings of sheet aluminium on a series of concentric polystyrene disc formers, then bonding them together with fibreglass and epoxy.

A "family" of horns is set into a rotatable turret, set off-axis from the dish's focal point. Any required horn is brought into position at the focal point by simply rotating the turret.

Each feedhorn is followed by two pairs of very low noise amplifiers using FETs which are housed in a Dewar so they can be cooled to -263° C with liquid helium. This is to reduce the contribution that thermal noise makes to the electrical noise all amplifiers generate.

The receivers are superheterodyne types, as is your AM or FM tuner or radio, the incoming signals being mixed down to a convenient "intermediate" frequency, or IF. The bandwidth here is 256 MHz from each of the four receiver outputs. At Mopra and Parkes, these signals are digitised and at a very high rate and recorded on tape using special high speed digital recorders. A single tape holds up to 24 hours of data. These tapes are sent to Culgoora for processing. At Culgoora, the receiver IF outputs are digitised at 512 million bits per second (Mbps) and sent via optical fibre to the control building.

The IF signals are processed at Culgoora using large correlators, which compare the characteristics of the signals in thousands of samples each second. These operate at 16 MHz in parallel-processing groups of 16 providing up to 1024 correlator channels running at input rates up to 256 Mbps. CSIRO's Division of Radiophysics designed a special purpose correlator chip to handle such a huge stream of data and 6000 were fabricated by Austek Microsystems in Adelaide using a 2.5 micron HMOS process.

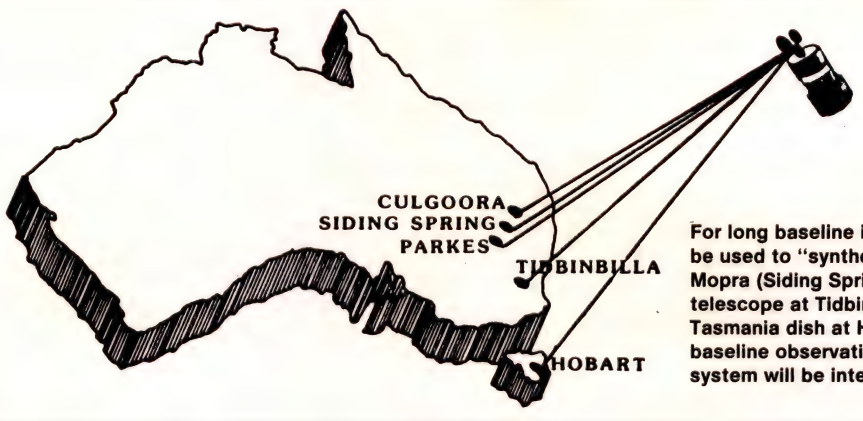
Three correlators are at Culgoora, and one at each of the other two sites. Some 300-odd printed circuit boards were required for the correlator systems.

Why use fibre optics?

In earlier multiple dish telescope arrays, coaxial cable has been the choice for conveying IF signals to a control building. But coax has two drawbacks: severe bandwidth limitations and considerable loss where distances greater than a few hundred metres are involved. Low-loss waveguide was used for the Very Large Array in New Mexico, USA, which was completed in 1980. However, the waveguide was very expensive and because of today's costs, could not be considered for the Culgoora installation.

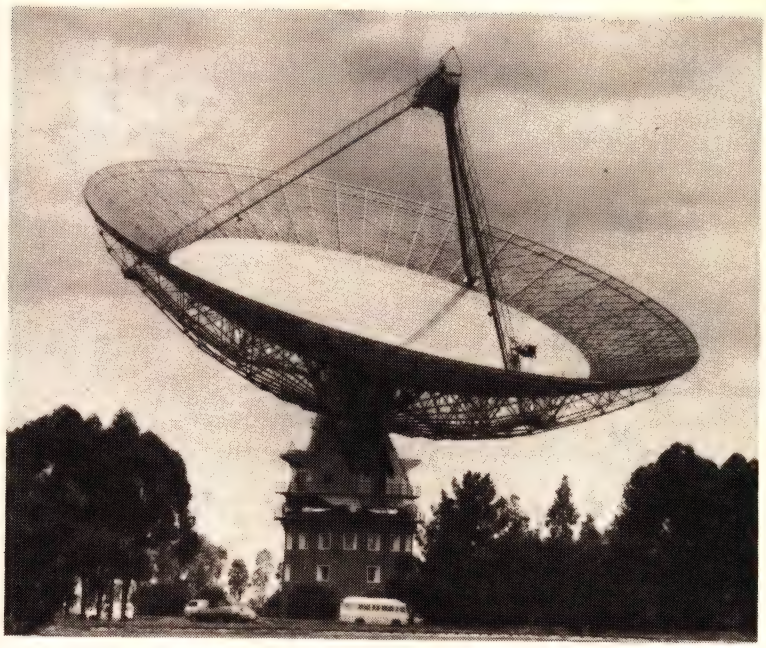
Optical fibre, which can carry very wide bandwidth optical signals, is a technology that has rapidly developed in the last five years or so and glass optical fibres offered a low-cost, easily installed, readily available solution.

With the six antennas, the combined signals from a single



For long baseline interferometry, antennas spread over 1400 km will be used to "synthesise" a dish of that effective size. The Culgoora, Mopra (Siding Springs) and Parkes dishes will be linked to the 70 m telescope at Tidbinbilla near Canberra and the 26 m University of Tasmania dish at Hobart. Very accurate timing is required for long baseline observations and to achieve this, timing signals for the system will be interlinked via AUSSAT.

The 22 m antenna of the AT near Mopra Rock in the Warrumbungle Ranges, near Coonabarabran, NSW.



The 64 m Parkes Radiotelescope, now a crucial part of the AT project, as well as a significant instrument in its own right. This instrument, now some 25 years old, has been substantially improved as part of an upgrading programme, as well as to fit with the Australia Telescope project. It figured recently in the discovery of a unique pulsar in a group of stars known as 47 Tucanae (see News Review, page 6, AEM, September). This new pulsar is unique in that it spins at about 15 000 rpm, about 150 times faster than most pulsars.

day's tracking of a celestial object give only a "patchy" radio image of whatever's in the field of view. The image is slowly built up by repositioning the five antennas at any of 37 different locations along the linear rail track on different days.

With four outputs per antenna, digitised at 512 Mbps, over 2000 Mbps must be conveyed to the control building over distances averaging 1 km. This calls very wide bandwidth and very low loss. Each cable contains four fibres and special military-type connectors are used at each antenna and each station to withstand the environmental extremes encountered.

The digitised IF signals are sent as pulses of light down the fibre, using solid-state laser diodes operating at 1300 nanometres (nm). Timing, control and monitor signals are multiplexed on the same fibre, using LEDs operating at 850 nm. The optical "receivers" at the other end employ solid-state avalanche photodiodes.

Fibrenet Pty Ltd of NSW supplied $100 000 worth of connectors and splicers for the optical fibre components of the AT. Fibrenet is an Australian company which specialises in optical fibre technology and applications. Their main business is manufacturing optical fibre test instruments and installation accessories.

As agents for the ICI-Stratos manufactured fibre optic connectors used on the Australia Telescope project, Fibrenet assembled and tested them here and shipped them as completed assemblies into the various components of the Telescope.

Spin-offs

The AT has achieved more than 80 per cent Australian content, according to the CSIRO. They claim it has brought about innovations in design which will provide spin-off benefits to local industry.

Among the benefits claimed are: experience in lightweight feedhorn design, the design and assembly of low temperature receiver systems, the design and manufacture of very large scale integrated (VLSI) circuits for high volume processing correlators and sophisticated image processing computer software.

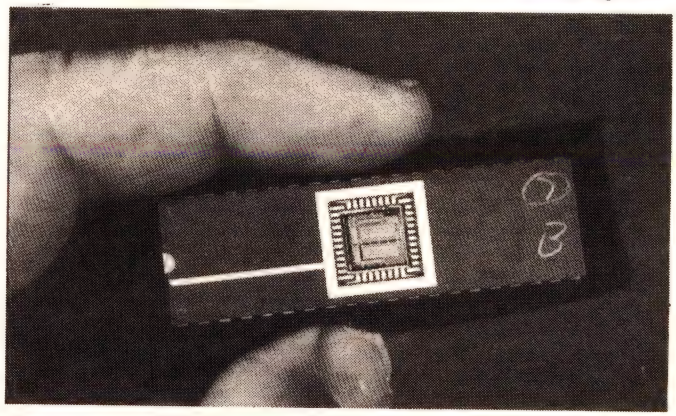
Because the accuracy of the dish surfaces must be better than one-tenth of the wavelength of the received radio signals, deflection and sagging had be kept within a range of only a few millimetres, and the relative deflection had to be kept within a few tenths of a millimetre of a best-fit paraboloid. The design has proved so successful in achieving this that a modified version is being used for OTC's new satellite Earth station antennas. One constructed by Johns Perry Ltd of Adelaide was recently commissioned at the new OTC location at Oxford Falls in Sydney.

The CSIRO and its consulting engineering firm, Macdonald Wagner, among the top five in the country, used Intergraph computer aided design systems on the Australia Telescope. And design of the antennas was carried out by Macdonald Wagner in conjunction with the CSIRO's Division of Radiophysics. Evans Deakin Industries of Brisbane built the dishes.

Macdonald Wagner bought its equipment in 1982, making it one of the first Intergraph customers in Australia, and uses an Intergraph 751, two Intergraph InterAct workstations and four LSI workstations, supplied by local firm Intergraph Corporation, located in Sydney (see *Bytewide* AEM, Jan. '86, p.15).

Once the structural analysis of the design was done, the data

• to page 53. ▷



One of the correlator chips, produced by Austek Microsystems of Adelaide. The chip itself, visible here in the middle of the package, is 5 mm square and comprises over 50 000 transistors!

Down on the levy blues — tape it now!

International recording companies and Australian artists are set to make a killing, according to some industry sources, through legislation the Attorney General's Department is set to inflict on blank tape users.

Every blank audio tape you buy stands to carry a levy - $1 for C60s is the proposed figure — that purports to compensate the artists and record companies for your illegally dubbing their music.

That you may have bought your blank tapes to record lectures at classes, music you make yourself, voice correspondence with friends, records of important moments in your life, dictation, audio timeshifting, computer programs, answer machine messages, interviews — for journalists — and a myriad of uses unrelated to dubbing music illegally is not going to save you from the levy, although some "statutory declaration" and claimback idea has been proposed.

Only Australian artists will get at the money the levy takes from blank tape buyers. Overseas artists, if theirs is the music you are into dubbing illegally, will not get a red cent.

The system ignores the impossibility of getting perhaps only one track from an album, if it is only one you want, instead of having to part out for a whole disc or tape.

Also, records that record companies have out of stock, and which are available to you only if you dub from a friend's disc or off the air, will still incur the levy on the blank tape.

This is "heads I win tails you lose", as whether the record companies can supply a disc/tape you are happy to buy, or they can't and you get it by other methods, you still pay: for service or no service at all.

Videotape is exempt: bureaucratic machinations will see you are squeezed to keep the record companies in the state to which they are accustomed for audio while you merrily pirate films off hired tapes or TV stations.

The best idea is to dub your audio on 8 mm videotape. This format will give you up to 18 hours per 8 mm videotape, at high quality. Then you escape the levy, because bureaucracy says it is videotape.

And from the sublime to the ridiculous, it appears that microcassettes will attract the levy because they are "audio tapes".

Now microcassettes have a useful function at dictation quality, but at their cost and the cost and performance of microcassette recorders no one would seriously consider dubbing their illegal music on to microcassette.

So journalists, students and letter dictators, take heart that the tapes you buy for your microcassette will help Australian musos when they are down and out.

The proposal has aroused the Australian Audio and Video Tape Association to oppose the Canberra-proposed levy. The AAVTA represents the country's leading tape marketers.

Secretary Ian Prosser points out the extent of home taping could never be quantified nor could the effect on copyright owners.

"At a time when sales of blank cassettes are static, while music cassettes and CDs are enjoying a boom period, we see the push for a blank tape levy as cynical and unnecessary," Prosser said.

Copyright owners were receiving ample compensation through selling original material, he said. "They now expect the consumer to pay for the privilege of taping his or her own LP record on to a cassette for use, for example, in their own car cassette system.

"For those consumers who buy cassettes for non-copyright purposes, the scheme will enable a refund. However, proof of purchase together with a statutory declaration will have to be produced before a refund is made by the Copyright Collecting Society.

"The scheme will be cumbersome, costly to administer and a burden on consumers who will have to pay a levy and get very little in return."

Prosser said AAVTA also noted that in a time of industry deregulation, the government was proposing a new regulation on business and consumers to benefit a small minority of wealthy international record companies.

Pioneer puts in the boot

Pioneer Electronics claims to have put other car audio systems in the back seat with their boot-mounted CD player system.

The CDX-M100 uses a six-disc magazine (JD-M100) to provide six hours of uninterrupted playing. The KEX-M700 is a single DIN- sized command unit which mounts in the dashboard, and offers control over the boot-mounted CDX-M100 as well as the more conventional cassette and AM/FM radio operation.

The system is designed with security in mind. Boot-mounting and the "*SECRET CODE*"™ on the KEX-M700 reduce the likelihood of theft. The remote control unit enhances convenience and improves safety when driving.

The CDX-M100 mechanism is suspended on an air-damper mechanism to overcome potential mistracking problems over rough roads.

The system retails for less than $2000. Contact your local Pioneer dealer for more details.

Singing along with Amstrad

Sneaking a look at the Amstrad Studio 100 before we review it, this 3-in-1 not only has tapes and records with FM/AM/LW tuner and auxiliary CD input, it doubles as a recording studio mixer for monitoring and mixing the user's multi-track productions.

It sports a DJ console for mixing, fading and echo effects plus voice-overs. Add graphic equaliser, twin-cassette decks, and four microphones. Also supplied are headphones and drum and music backing tape.

The amplifier has 10 W RMS per channel with a quoted frequency response of 20 Hz to 20 kHz. The two-speed turntable is belt-driven. The FM stereo tuner covers 87 to 109 MHz; the MF unit 520 to 1650 kHz: and the LW section 145 to 290 kHz.

Mixer inputs total six: microphone or line, switchable off/mic/line/tape. Metering consists of tracks 1-4 VU, L and R output level; and 6 (4 + 2) track share mode.

The tape decks are one studio 4-track rec/play, and stereo 2-track rec/play. This gives four tracks on the studio deck and two channels on the stereo one.

New QED amps

British hi-fi manufacturer QED has introduced the Mark II versions of their successful A240 amplifiers, featuring a 430 mm wide chassis, non ferrous construction, fully discrete circuitry and a "Record Out" function selector.

The A240 CD is rated at 40 W/ch into 8 Ohms (both channel driven), 0.1% THD, and -80 dB signal-to-noise ratio on the tape, CD and tuner inputs. It will sell for $699 rrp.

Similar to the CD but with an improved phono section, including an MC input, the A240 SA will set you back but $899. Some $699 will get you the new T260 Tuner, now including AM and 12 preselectable inputs.

QED products are distributed by **Leisure Imports, 102 Glover St, Cremorne 2090 NSW.**

Symphony of the Planets

A series of new loudspeakers from Tannoy, the Planet Series, has been completed with the M20 Gold Mk2 and the Jupiter S being added to the Eclipse and Mercury S.

These are now all cosmetically similar and share the same ferrofluid cooled, polyamide diaphragm tweeter.

The acoustic matching faceplate design of this tweeter has been refined to a point where it can be used on all four products.

The M20 Gold Mk2 shares the dimensions of the Mercury S and has flush fitting baffle and full length grille. It exclusively has the facility for bi-wiring from the amplifier and has gold-plated terminals. It is finished in walnut or black real wood veneer.

The Jupiter S is a twin 200 mm system with a high sensitivity of 91 dB and peak power of 150 W. When coupled with the extended low frequency response, this system is capable of dramatic performance, says Tannoy. It is available in black ash finish only.

The Planet Series of Tannoy speakers is available from Hi-Phon Distributors.

On-the-wall TV screen

A further step towards the ultimate colour TV screen, in thinness, comes closer through Sharp's 350 mm LCD unit. The TFT (thin film transistor) screen is so light at less than 2 kg it can be carried from room to room, and with a thickness of 27 mm, it can be hung on a wall like a painting.

The developer claims the colour image is sharp and clear, with 308 160 pixels.

Another development from Sharp is an active matrix-drive system which allows individual pixel control through a high performance thin-film amorphous silicon (a-SiTFT) transistor.

This provides a response speed faster than 17.5 m/sec and makes it possible to reproduce full-colour pictures with a high contrast ratio of 100-to-1 and detailed colour graduations.

Another Sharp original drive system reverses the voltage direction each scanning line, eliminating picture flicker.

The 350 mm flat screen, which Sharp says will go into commercial production next year, opens up a host of applications in advertising, home entertainment, public and private information displays and presentations.

It follows Sharp's 75 mm LCD colour TV last October, and this October will see a 100 mm model released by Sharp in Japan.

TDK unreels new audio tapes

Just when you thought it was safe to splash out on audio tapes before Canberra implements its "everybody pays to keep musos in the state they're like to be accustomed to" tape levy, along comes TDK with a range of new tapes aimed to change your buying habits.

The maker says its eight tape grades covering three positions is compatible with digital sources, boasting frequency ranges from 5 Hz to 20 kHz, dynamic ranges of 96 dB.

In addition, they have high output, low bias noise, well balanced high sensitivity and low modulation noise, say TDK.

The new D, new AR, AR and AR-X are type I/normal position tapes, each with slightly varying specifications and cassette mechanisms.

The SF, SA and SA-X — all new — are the type II/high position tapes. The type IV/metal range consists of the new MA-X and the MA-X. The MA-XG has the improved formulation of the new MA-X but retains the reference standard mechanism.

Before prospective tape buyers reel out of shops without tapes, confused by the choices before them, TDK has published two booklets to help. The *TDK Guide to Better Recording* and *TDK Audio/Video Cassettes* guarantee that anyone who has swotted them can hold up his head and his end of the conversation in any hi-fi shop with pride.

You can learn from chapters such as "What is better recording?", "The importance of meter readings"' "Good cassette recording techniques", "Important properties of cassette tapes" and "How to make a good cassette".

Both booklets are free at any record shop or department store, or from TDK.

Just be careful not to go to the next naturalisation ceremony at your local town hall instead of the weekly Rotary meeting, and announce your subject for the talk that evening as a chapter from the TDK "Better Recording" book, entitled "The Importance of Bias".

New speaker cables

Increased conductivity and less capacitance is claimed for new silver slim line, "professional standard", flat profile speaker cable from Arista.

Each strand of the 2 x 2.5 mm^2 and 2 x 4 mm^4 conductor cables is individually coated with a thick plate of silver, and the winding technique is to weave the cable rather than twist it and then put it through a press to flatten it.

Not silver-plated, but identically constructed and less expensive, two identically sized twin conductor cables claim a stronger signal transfer than common speaker cables, resulting in a particularly clean bass response, according to Arista. See your local Arista stockist.

DATAK

Our range of DATAK products has proved enormously successful: small wonder, this quality product, made in the USA, makes virtually every aspect of PCB making a breeze. Below are just some of the DATAK products – many reduced to tempt you to try them!

Etch Resist Pen

Remember the pen we used to sell? We stopped selling it when we found out the resist was a deadly poison (others still sell it!). The DATAK etch resist pen is a non-nasty, highly effective way to make one-off PCB's. Cat N-5180

$4.95

Datak Burnishing Tool: Save $3

You'll need one of these if you're at all serious about making PCB's. Cat N-5715

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Datak Circuit Fix It Kit: Save $13

Eventually, you'll get a PCB that's RS. Fix it with Cricuit Fix Kit. Pure Copper traces & donuts with adhesive backing, ready to repair a PCB or modify a new one. Great for developers too. Cat N-5900

Was $62.95

circuit fix kit

NOW $49.95

Dry Transfers

DATAK make some great transfers. To whet your appetite (no, Lucretia, you don't eat them) here are two.

SAMPLER ASSORTMENT, containing 17 different sheets. A great starter pack. Cat N-5766

~~$19.95~~ **NOW $16.95**

TARGETS & REGISTERS, containing 40 different pcb & crosshair registration marks for precision alignment. Cat N-5820

~~$7.95~~ **NOW $4.95**

UNIVERSAL DIL PATTERNS, allowing you to make any DIL pattern up to 40 leads. 48 in pack. Cat N-5768

$14.95

Datak Contact Frame: *Save $6*

Yep, you'll need one of these too. If you're serious, that is. Beats the old sheet'o glass and two books routine anytime. Cat N-5710

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NOW $29.95

Resist These Bargains? Unlikely!

DATAK quality resist products to make your PCB making a breeze. They're also refills for the DATAK PCB kit

Developer	Resist	Filter
N-5905	N-5907	N-5711
Was $11.95	Was $18.95	Was $10.95
Now $9.95	**Now $15.95**	**Now $6.95**

Pos/Neg Film Refills

Photo-sensitive polyester film suitable for laying out PCB patterns in pos or neg format. 6 sheets 125 × 150mm. Cat N-5705

Was $18.95

NOW $15.95

Film Processing Chemical Pack

Film developer and fixer pos/neg film, or for replacement pack for PCB kit. Cat N-5909

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NOW $9.95

DATAK PCB designing and making material – exclusive to Dick Smith Electronics.

You've asked for them: an economic range of tapes, pads, lettering and so on for designing PCB patterns, marking panels and so on. Here they are!

TITLES, LABELS, NUMBERS, ETC:

A great range of wording ready for your front panel or other marking applications. Dry transfer lettering: simply rub over them with a suitable burnisher (such as a ball point pen).

Audio, TV & Hi Fi

Five sheets containing titles for the above applications plus one letter/number sheet. Available in Black (Cat N-5753) or White (Cat N-5754)

Amateur Radio & TV

Similar to above, five sheets to pack, with letter/number sheet. Black (Cat N-5755) White (Cat N-5756)

Test & Industrial Equipment

Completing the set: 5 sheets for CRO's, meters, analysers, etc etc. Also includes letter/number sheet. Black (Cat N-5757) White (Cat N-5758)

ALL ABOVE SETS: **$8.95**

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Four sheets with dial plate arcs & graduations to let you customise any meter movement. Suits meter radii from 25 to 125mm. Black only. Cat N-5752 **$14.50 set**

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.031in (N-5780)	.080in (N-5786)
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DONUTS – precision cut donuts to accurately match tape. 380 donuts in each pack, all .031in OD on 0.2in × 0.3in centres

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.125in OD – N-5774 **$4.25 pack**
.150in OD – N-5776

PATTERNS – Various styles suit most applications.

TO-18 Pattern (3 pin), 144 in set. Cat N-5760
TO-3 Patern (3 pin), 84 in set. Cat N-5762
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Not like your old ones: these fit flush on the power point to create a double power point from a single. If you already have a double power point, you can fit the "twin" Spacesavers to make a 4-way outlet!

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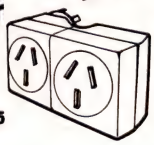
NEW!



Fits to a single outlet or to the right hand outlet of a double, extends to the right hand side. Cat P-5442 **$3.95**

Twin Pack Spacesavers

Fit to both the left and right outlets of a doub power point to turn it into a 4-way outlet on t wall. Ideal for stereo systems, computers, etc Cat P-5444

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How about a bit of protection?

If you're running sensitive equipment, (computers, video & TV, etc) you should know that spike or surges on the mains can damage or even destroy it, or destroy hours or days of work on dis The Surgebuster series of mains suppression filters virtually eliminate these surges: in fact, they're so sure of themselves they offer $5000 FREE INSURANCE COVER against voltage spikes or power surges!

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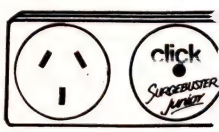

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The best of both worlds: a six way power board – with all outlets on that board protected against surges or spikes. It's also overload protected. And yes, it too comes with the $5000 insurance cover Cat P-6515 **$59**

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How were the Olympics? Twenty runners in each heat? Two high-jumpers on the bar at once? need a new antenna! Dick Smith Electronics has a huge range of antennas – there's one right f your area (ask for free, helpful advice at your nearest store). Here's just a small sample:

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It's a great all-round performer for the typical suburban home (regardless of city). Easy to erect, good f/b ratio and very good value for money. Cat L-4022

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Band IV and V

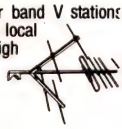
What a performer! Covers all UHF channels, so if you've got both bands got you covered! Butterfly elements, gold anodised finish for long long life. Cat L-4084 **$99**

Band IV UHF

If you're in a capital city, chances are you only want channel 28 UHF. This band IV antenna is perfect – and it won't break the bank! Cat L-4082 **$65**

Band V UHF

A great performer for band V stations (which include most local area translators). High gain, easy to erect. Cat L-4080 **$59.95**



Accessories, Too:

Barge Board Mount: Easy way of getting the antenna up from a vertical surface. Cat L-4150 **$1**

Short Mount: Designed to hold vertical masts. 28cm long, with saddle clamp. Cat L-4152

Longer Mount: As above, but 69cm long to clear eves, etc. With saddle clamp. Cat L-4153 **$1**

Mast Section: 2.4m galvanised pipe for mounting antenna. 27.5mm diam. Cat L-4156

Telescopic Mast: 4.8m galvanised telescoping mast for that extra height. Cat L-4157 **$2**

Saddle Clamp: 90 degree V-block and U-bolt assembly for holding mast to mount, antenna to mast, etc. Cat L-4165

2-way Splitter: Inside splitter for running two TV's from one antenna. Suits 300 Ohm cable. Cat L-4218

4-way Splitter: As above, but for running up to 4 TV's from one antenna. For high signal levels. Cat L-4220

2-way 75 Ohm: Use with coax cable installations for running 2 TV's. Inside use only. Cat L-4270

4-way 75 Ohm: As above, allowing 4 sets from one antenna. Suitable for strong signal levels. Cat L-4474

Baluns: Used for converting 300 ohm system to 75 ohm and vice versa (eg coaxial lead to an old TV with 300 ohm antenna inputs).

Universal: Inside use only. Cat L-4456

Outside: Protected from the elements. Cat L-4465

Masthead Diplexer: Combines the signals from UHF and VHF antennas, allowing one cable run. Cat L-4469 **$1**

Indoor Diplexer: Used where TV set has only one antenna input but VHF and UHF antennas need to be connected. Cat L-4476

TVI Filter: High-Pass filter for VHF & UHF TV, eliminates or reduces interference from CB, HF amateur, etc. Cat L-4475

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Soldering, silver soldering, glass bending, heatshrinking, even small brazing – they're all easy with this superb little tool. Butane powered (standard cig lighter refills) with controllable flame down to near pin-prick. All in a tiny (200mm long x 13mm diam) hand-held torch. Cat T-1380

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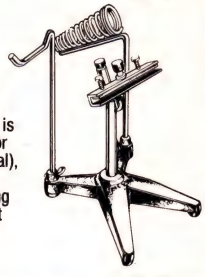
½ Price Superstand



Hobbyists – repair shops – labs – assembly benches – if there's one item your bench really needs, this is IT! Heavy cast base with stands for Soldering Iron (complete with spiral), solder rol AND an adjustable vice with 360 degree rotation for holding and turning pcb's. One of our most popular stands – our bulk buying saves you money Cat T-5700

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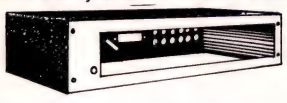

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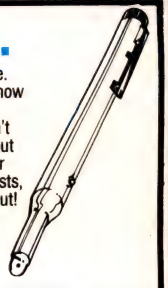
We've raved about these in our catalogue. We've told you how fantastic they are – now they're in stock so you cand find out for yourself! AC Voltage detectors which don't rely on contact – so they're S-A-F-E! About the size of a small marker pen, perfect for electricians, maintenance people, hobbyists, everyone! First shipment is almost sold out! Cat Q-1530



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12V Tester

Another beauty: this one's for auto cable testing. Actually pierces the insulation without removing cables, gives no go/maybe/good indication with 3 leds. Also tests HT pulses from distributor. Look at the price! Cat Q-2000

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Most hobbyists need two multimeters: their good bench meter (often a digital) and a cheapie – one that can take the rough and tumble, and doesn't cost a fortune. This one's the latter category: but for the low low price you get a great 10k/v meter with 1[illegible] ranges including 2 battery check scales. Includes probes. Cat Q-1015

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Huge range of moving coil and digital multimeters from only $17.95

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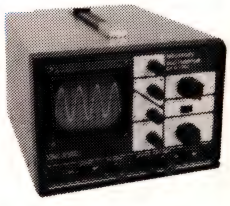
Most hobbyists need a CRO – most don't have one. Once you've used a CRO you'll wonder how you got on without it! This one won't break the bank, but gives a usable response to beyond 6.5MHz – ideal for most users. Try it: you'll like it! Cat Q-1280



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60 Meg Probes

Here's a value-packed set of probes for CRO use. Multiple piece set, with x1x10 switch, 60MHz bandwidth all in a handy plastic pouch. Cat Q-1247

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If you're birdsnesting or even doing a lot of circuit testing, these multi-coloured test clips are great. Mini size, come in a variety of colours. And they're near half price this month! Cat W-4588

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Surround sound — a maturing technology

Ben Furby

Stereophonic sound reproduction has held sway in the audio world for thirty years. Quadraphonic sound, which reared its head in the early 70s, was the first commercial attempt to "recreate" the sound ambience experienced in live situations. But it flopped, for several good reasons. Today's Surround Sound employs a technology that benefits from much research and seems set to achieve that once-elusive goal.

THERE'S A UNIVERSAL reaction to demonstrations of surround sound: you marvel at the different effects, from church to stadium to jazz club, and politely agree with the nice guy doing the demo that it really does sound very nice.

Actually, you do go along with the idea and think it's a nice gimmick, but you wouldn't spend a thou or more of your hard-earned dollars on the gizmo, much though you liked it.

Then, after he's run through all the features your friendly helpful hi-fi demonstrator switches the thing off and returns you to normal, hi-fi stereo which is only marginally better than the set-up you have at home. *AND IT SOUNDS AWFUL!*

Well, that's a universal reaction to flying high with surround sound and then crashing back to a landing hard enough to give your hi-fi hydraulics a real shake-up in the Eustachians. So if you haven't been to hear surround stereo, you haven't lived. Yes, I know this was said about FM broadcasting, but this is different.

Background

The basic idea is not new, in that you are sitting before your stereo hi-fi listening to a Bach chorale such as you might hear in church, or Beethoven's 10th in the Sydney Opera House, but the acoustics of your cramped living room sound nothing like the spacious areas of cathedral or opera house.

Anyone alive today who was conscious and literate during the early 70s might remember that quadraphonics was going to create that spatial illusion with four channels. Two for the stereo and two for the sound recorded from the two back corners. Then with a lesson that Beta and VHS video failed to heed, the whole thing foundered on incompatibility of standards. Now it's back in the form of "surround" sound, but it's considerably different from quadraphonics.

Yamaha's Sydney representative, Tony Brigden, told AEM that quadraphonics supplied two channel stereo, with two other channels for the right and left rear speakers. You were stuck with it: you had to take it as supplied.

With Yamaha's DSP-1 surround sound processor, however, you take a basic two channel stereo signal, and then enhance it with different delay patterns to sound like a cathedral, a stadium, or different halls. But greater detail later.

Dolby first

Dolby was early in the game, and in the days before the inevitable large scale ICs came along, its equipment was expensive. So expensive that it found its niche in cinemas, with its costs borne by the industry.

Dolby Stereo surround encodes the surround information within its regular left and right channel sound tracks and is generally compatible with standard stereo systems. The surround channel is recovered by suitable decoders in the playback gear, if needed.

Now, the price of decoders has dropped within reach of the home hi-fi enthusiast's pocket. Also, video films taped with Dolby surround are becoming available in growing quantities so you can get the benefits of the acoustics of a large cinema into your own front room by combining a surround sound decoder with your video/TV setup.

An essential feature of Dolby stereo surround is a time delay in the surround channels, following after the main channel signal. Not perceived by listeners, it has the effect of preventing sound images being "pulled" from the stage when the same sound occurs in the surround and centre channel speakers. Without that delay a listener near a surround channel speaker might think the sound source was that speaker.

Dolby surround features among the products from Kenwood, NEC, Pioneer, and Sansui. Product manager, Geoff Cottee of NEC agrees that surround sound has been slow to take off, and said NEC sold only through specialist dealers who were able to demonstrate it in sound lounges.

"The concept is gradually gaining," Mr Cottee told AEM. "Software suppliers are beginning to supply encoded material."

Dolby Surround sound is also found in Yamaha's products, such as the DSP-1 surround sound processor, and now the same type of circuitry in the DSR-100 Pro digital sound field processor as in the Dolby Surround circuitry used in cinemas.

Literature we received from Yamaha says conventional Dolby Surround was aimed exclusively at the consumer video market. While it provided an exciting addition to movie enjoyment, and many Yamaha products included it, it was a limited system providing an L-R signal routed to the rear channels in proper amplitude and proportion. Both rear channels carried the same information but were physically spaced apart to provide an apparently wide sound source.

"Many video enthusiasts have wanted a system in their homes which is closer to what they experience in movie theatres," says Yamaha.

"Dolby Pro Logic is a surround mode also created specifically ▷

for a visual medium, but uses circuitry developed for Dolby decoders for commercial movie theatres."

Since Dolby Pro Logic was conceived as a commercial format, expanding the apparent sound field was not a design consideration.

"However, because it was designed as a circuit for encoding and decoding specific directional information for movies, it is the best possible circuitry for that purpose." Yamaha's literature points out that the sound from your hi-fi is modified by the reflected sound in the room where you listen anyway.

Reflections in a public place

"Normally the auditory impression of the sound field in a hall is regarded as being composed of three elements: the perception of volume, of reverberation, and of extension," Yamaha's *Sound Field Creation* manual says. It continues that the most direct influence in perceiving reverberation was reverberation itself.

"This is something which needs to be understood fully. The time it takes a note to attenuate 60 dB is called the reverberation period, but the reverberation actually perceived is most definitely not in proportion to the reverberation time."

Things are not what they seemed to be, apparently. It appears the reverberation time is in proportion to the volume of the room, and also inversely proportional to the average absorption ratio. This is a parameter which gives a percentage of absorption in relation to the internal surface area of the room.

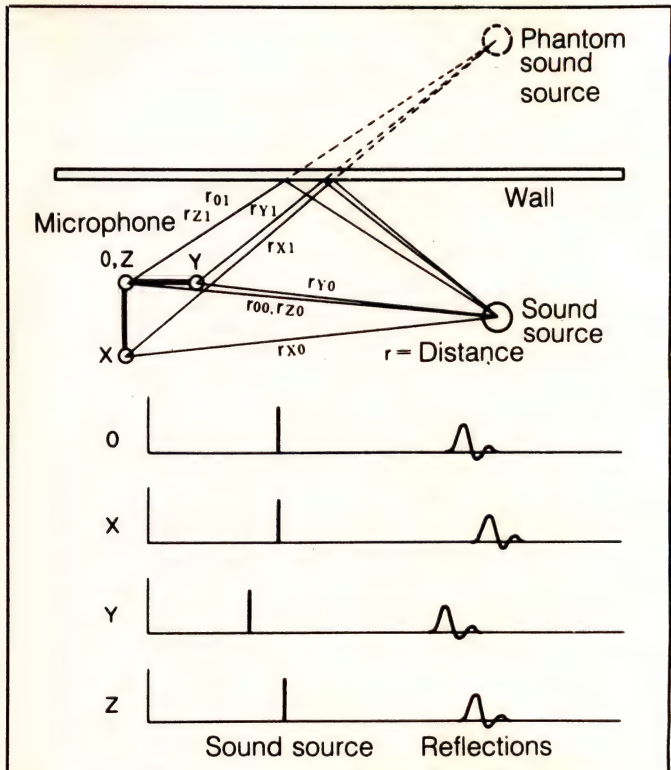
So if you madly carpet the floor and hang tapestries and Persian rugs from the walls and put curtains over your windows the absorption rate goes up faster than the Japanese yen the day you've saved up enough for that overseas trip.

To cut a long story short, Yamaha has carefully analysed the time delays in reverberations from some classic places where music is played.

"Humans, with only two closely spaced ears are generally able to perceive the direction in which the sound comes from," Yamaha says.

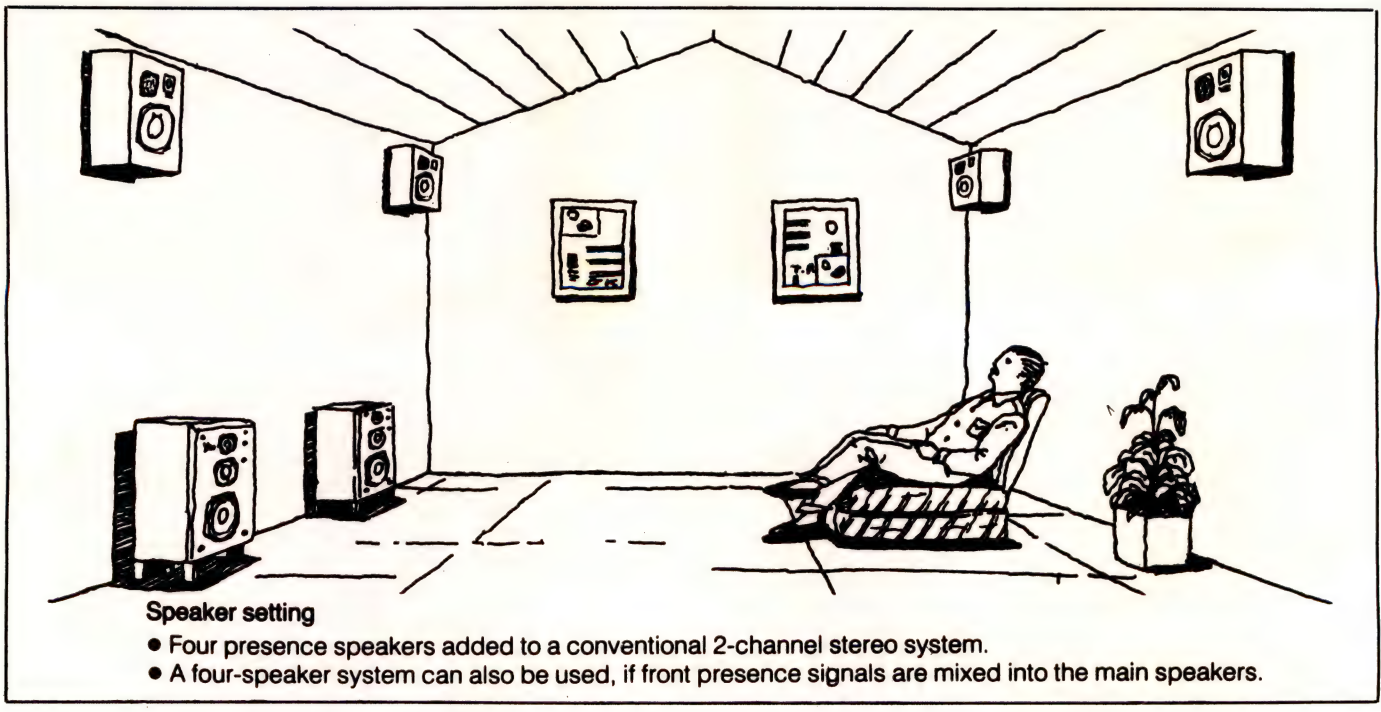
"For instance, a sound coming from the right is more distant from the left ear than the right ear, so the left ear naturally hears the sound later than the right ear. This time delay tells us that the sound has come from the right." Yes, OK, we know. That's why we bought a stereo hi-fi in the first place.

But with several microphones and an anechoic room with one reflecting panel the company carried out careful measurements to analyse the parameters of direct and reflected sound. With this experience, Yamaha set out to establish the sound parameters of some classic buildings. They went to four concert halls and two churches: Munich Philharmonic (Munich); Alte Oper (Frankfurt); Liederhalle Beethovensaal (Stuttgart);



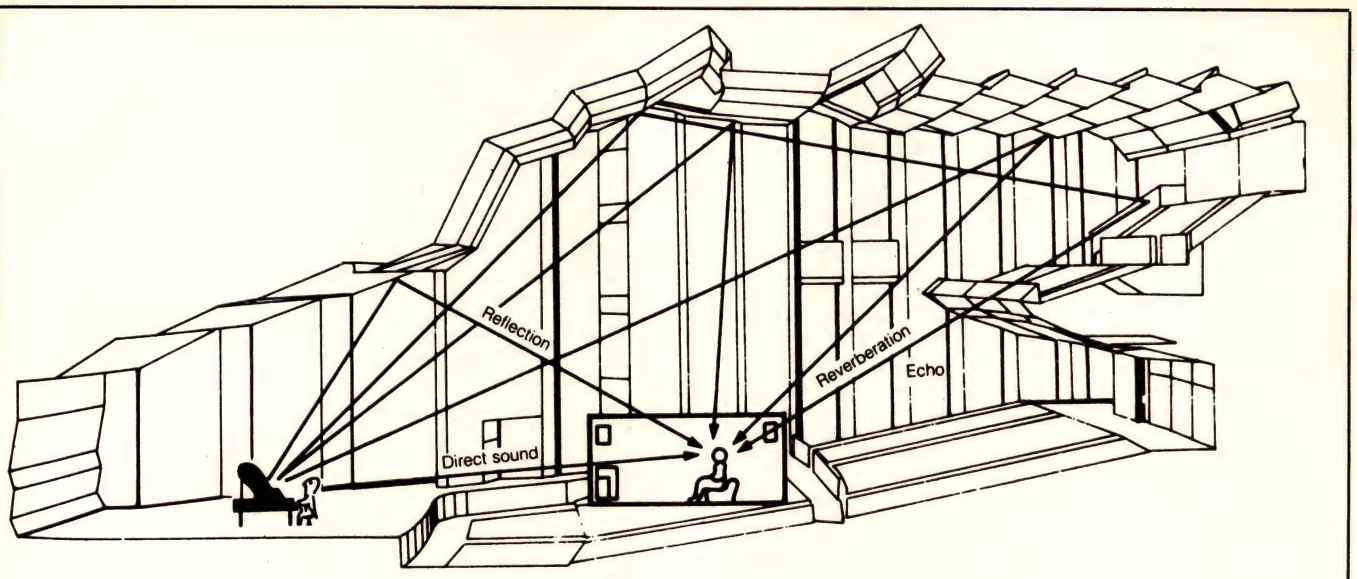
Anechoic room with single panel establishing the "phantom sound source" for Yamaha DSP-1 from angle and equivalent distance travelled.

Block diagram showing how Yamaha DSP-1 reproduces phantom sound sources with a speaker in each of four corners, supplementing the two hi-fi system speakers.



Speaker setting

- Four presence speakers added to a conventional 2-channel stereo system.
- A four-speaker system can also be used, if front presence signals are mixed into the main speakers.



Simulation of Concert Hall Sound Using Four Speakers

Reducing the Opera House to your living room: Yamaha's simulated sound using four speakers.

Herkules-Saal (Munich); Munster Cathedral (Freiburg); and St Mary's Cathedral (Tokyo).

In a programme of carefully measuring parameters of sound in these buildings, Yamaha said in an ordinary concert hall the most important reflections were those within 100 ms from the direct sound.

"The acoustic properties of the hall are represented almost entirely in the response patterns from the direct sound to 100 ms and do not change much after this.

"On the other hand, in churches reflections are relatively small in this range, gaining energy with time. Also, a localised distribution is transformed to an even distribution over all directions beyond the 100 ms range.

"These differences create the 'hall sound', 'church sound' or the like which are, even in the same category, subtly different according to the acoustic characters of the sites."

Yamaha's DSP-1

In Yamaha's DSP-1 digital sound processor system, speakers placed in four directions each combine with the adjoining speakers of the original hi-fi system. The signals are controlled in such a way as to recreate a large number of quasi-sound sources distributed among the speakers.

When considering a single phantom — or simulated source for a reverberation — this is the procedure Yamaha's DSP-1 follows:

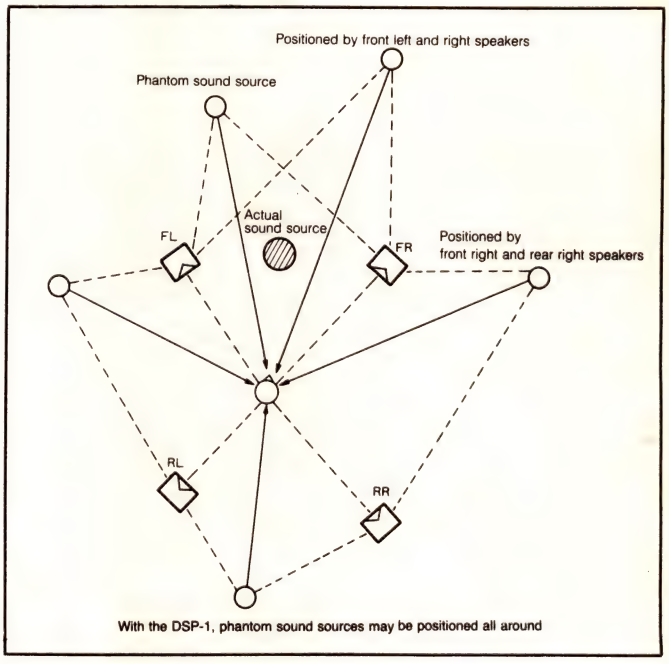
1. The delay time between the arrival of the direct sound and the reflections is derived from the distance between the phantom sound source and the point where the sound is received.

2. The strength of the reflection is determined from the strength of the phantom sound source.

3. The speaker for recreating the reflections is selected from the direction of the phantom sound source and the allocation ratio is calculated.

The DSP-1 carries out that procedure for all the phantom sound sources needed. Then it determines the strength and delay time of the signal to be supplied to each of the four speakers in time chart form.

This represents the preparatory stage in reproducing a hall, and when the particular hall has been selected, the DSP-1's internal microcomputer executes the execution. In this stage:



With the DSP-1, phantom sound sources may be positioned all around

4. The signal emitted at the position of the sound source is adjusted for the required strength and delay time and mixed, and put out through the speakers.

Delaying the reflection signal is done by a 24 bit x 16 Kword signal delay DRAM. Since the sampling frequency is 44.1 kHz the greatest delay possible with one set of memories is 371 ms seconds; with two sets connected in tandem a delay of about 750 ms can be achieved.

The DSP-1 contains encoded settings for 16 distinctive types of early reflection and subsequent reverberation, all based on measurement data from actual concert halls and other auditoriums. These data form the base for generating two general types of processed sound, Acoustic Surround and Sound Effector, which include parameters such as delay time, frequency characteristics, liveness, and room size. All these parameters can be changed easily by the user, and stored away as a separate user program.

So you can set up the best conditions for your living room and speakers while closely following the acoustics of the type of hall or room where the programme was originally recorded. ▷

Proof of the pudding

However, if you think all this is just gimmickry, we dare you to go and try it out for yourself. Have your friendly hi-fi demo guy play you suitable music for the Rock Concert mode. OK? Sounds all right?

Now, get him to play some Jazz Club music, in Jazz Club mode. Yes, sounds great, but..? Well, get him to switch the Jazz Club music into Rock Concert or Church. Now you begin to see that the colouration of the music is not just cosmetic, as they say in the beauty business.

It's moments like these that you begin to appreciate that there's more to life and hi-fi because life has now become impossible without hi-fi stereo and digital sound processors like the DSP-1. And until this moment you had not really lived life, you had just been a voyager through the space of time: a reflection bouncing off one of life's walls, but not living life from elemental fundamentals!

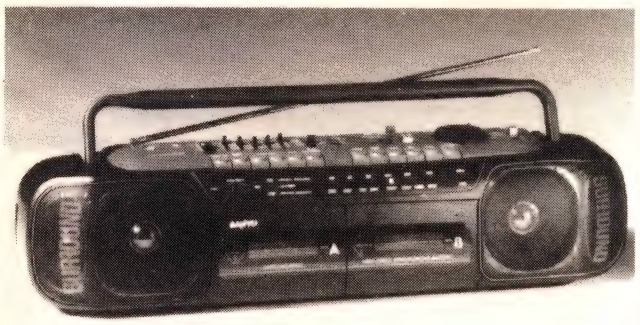
Which is where the editor gets into the act to point out that we are running out of space, because in magazine publishing we do not have a DSP-1 to expand the magazine's size by increasing reverberation time as you can in Church or Hall mode. "The proof of the pudding is in the eating," he said, showing how even editors can confuse the gourmet life with the other finer things like the delights of hi-fi.

What he meant was that now some basics of surround sound have been explained, further talk will not do a fraction of what a session at your local equipped-for-surround sound demos handy helpful hi-fi dealer can do.

At Len Wallis Hi-Fi at Lane Cove, Sydney, John Martin demonstrates Yamaha surround stereo.

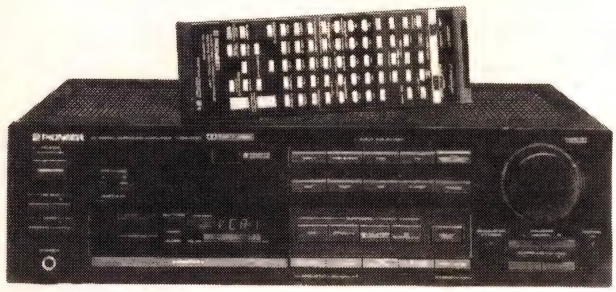
Of course, you realise life will not be the same afterwards? And better find out what you might sell your car for before you listen, so you'll know how far you can commit yourself in buying your Surround Sound stereo.

We gratefully acknowledge the assistance of Yamaha and NEC in the preparation of this feature.



SANYO

Sanyo has three radio cassettes with surround sound. They are the MW731F, RRP $179; MW738F, $219; and MV747F, $329.



PIONEER

With its commitment to LaserDisc, Pioneer has two surround units that offer multi-video inputs as well as audio.

The VSA700, a video system amplifier, will give you 100 W per channel for a pair of stereo speakers. But operate it in its surround mode, and you get 70 W per channel up front and 30 W per channel coming at you from behind. It offers four video inputs — VCR1, VCR2, TV and LaserDisc — and five audio.

Product manager Robert Costello told AEM that it would also dub tapes: "Brilliantly". It has Dolby and stadium surround sound, and "simulation" where the listener can set his own parameters.

"It's very comprehensive," Mr Costello said.

Selling surround stereo needed special demonstration areas, he said. But it appeared that going to this trouble with the $1299 (RRP) VSA700 was worthwhile.

"We can't get enough of them," Mr Costello said.

Pioneer also has arriving this month the VSP555, a surround processor designed as an add-on to an existing hi-fi. It has five inputs, its own two-way video dubbing, and it generates 30 W per channel for a pair of rear speakers. Its remote control includes L/R, F/R signal control to move the listener wherever he wishes. The VSP555 has an RRP of $799.

YAMAHA

Yamaha's virtual leadership in surround sound derives from its association with music and musical instruments. Perhaps a later comer to electronics audio, the company concentrated on surround sound instead of racing other hi-fi makers in a "me-too" contest.

Its DSP-1 decoder can operate on four channels but is really designed to work with six. The decoder takes the audio signal from the source — CD, tape, tuner, or TV — and digitises it. Its special IC processor can delay, enhance or whatever. If you have a six-channel system, your basic hi-fi installation emits the original music. The Yamaha four channel M35 20 W per channel power amplifier is used for the enhanced and delayed signal, creating the reverberation times of whichever mode you chose.

Prices: DSP-1 decoder, $1449; and M35 amplifier, $499.

Yamaha's Tony Brigden said the unit was selling well considering a buyer needed the decoder plus amplifier and four speakers.

Although the DSP-1 has a Dolby Surround setting, Yamaha Consumer Products manager Lindsay Woodland said it could not truly bring home the sound of the movie theatre and the excitement that went with it.

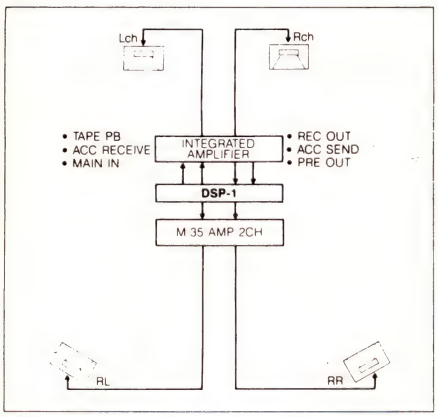
"Now Yamaha has introduced the DSR-100 Pro, a device which includes the same type of Dolby Surround circuitry used in movie theatres, and so many homes will find spaceships and jet planes roaring through their living rooms with exhilarating sound," Mr Woodland said.

By marketing a four channel Dolby Surround system Yamaha was overcoming its original objections to three channel Dolby: "While it provides an exciting addition to movie enjoyment...it is a limited system providing an L-R signal routed to the rear channels in proper amplitude and proportion. Both rear channels carry the same information, but a physically spaced apart to provide an apparently wide sound source," Mr Woodland said.

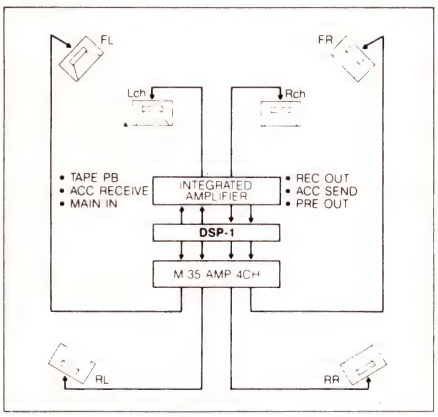
Enter the DSR-100, with an RRP of $899.

"Yamaha...has taken the basic Dolby Pro Logic circuitry and created an original LSI (large scale integrated circuit) for the digital delay circuitry," Mr Woodland said.

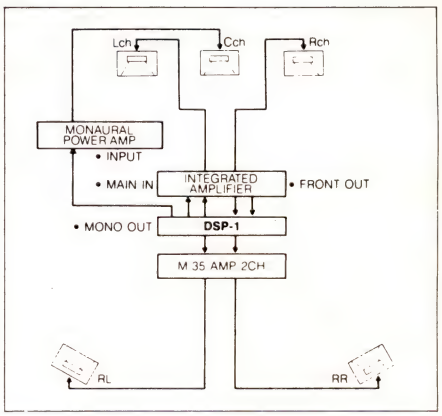
"Other unique features ...include a master volume control which uses seven voltage controlled amplifiers for precision adjustment of each channel's volume, a built-in test tone oscillator so that the system can be easily installed and balanced, and an interface for Yamaha's DSP-1 digital surround processor."



4-Speaker DSP-1 System—Yamaha M-35 power amp set to 2-channel operation drives rear presence speakers. Mixed main and processed signal is fed through main speakers, driven by integrated amp.



6-Speaker DSP-1 System—Yamaha M-35 power amp set to 4-channel operation drives front and rear presence speakers. Processed signal is fed through presence speakers, main audio signal is fed through main speaker pair, driven by integrated amp.



5-Channel DSP-1 System—Same set up as 4-speaker system, with the addition of central mono presence speaker or superwoofer. Mono signal output provided on DSP-1; additional monaural amp required.

NEC

From NEC there is the AVR-700E digital synthesised receiver with Dolby and Matrix. with an RRP of $1399. This unit will supply 70 W per channel for front speakers and 35 W per channel into the rear speakers.

There is also the AVD-700 Surround Sound Decoder, RRP $1499, with 10 inputs to accommodate five video and five audio components such as CD, FM receiver, tape deck, and turntable.

The decoder, which has two channels for a stereo front amplifier, and outputs for centre and rear amplifiers, offers Dolby, Hall, Matrix (stadium or outdoor arena for sports or concerts), and Creation: where the user designs his own surround sound to personal taste. The Spatial control adjusts the sound field and delay time, and the sound selector combines video and audio. This unit also features a 42-function remote control with memory.

The sailor's friend

Ben Furby

Chronometer, weather forecaster and navigator: relatively inexpensive for what it does, the Dick Smith Electronics direction finder radio is one of the treasures for small boat sailors hidden away in the DSE catalogue.

WEIGHING JUST 3.9 kg, powered from its internal batteries and measuring 405 x 170 x 303 mm, the direction finder (DF) receiver is economical enough in weight, size, power and cost for the smallest yacht running outside Sydney or Darwin Harbours.

The chronometer function is an easy one. Pick up time signals from the broadcasting stations you can get on the medium frequency (AM) and FM broadcasting bands. Or do it by receiving WWV frequency and time standard broadcasts on 5 or 10 MHz, because this receiver also has shortwave bands covering 3.9 to 12.5 MHz. It will also receive the Australian frequency and time standard transmissions from VNG when it returns.

It is from the broadcasting stations, too, that the yachtsman can get weather forecasts. And if you want to listen in to marine and aviation VHF bands, the receiver covers 59 to 218 MHz as well. However, it is in its primary design rôle as a direction finder that the set can be very useful.

First, some introductory remarks on the theory of DF.

The art of DFing

As you rotate a directional aerial through 360°, the received signal's strength climbs to its highest as the aerial points to the transmitter. As the aerial continues its swing, the signal strength fades. At 90° from the point of strongest reception, when it is now pointing at right angles away from the transmitter, reception is at its weakest, or it fades away altogether.

But as it passes 90°, heading for 180°, the signal's strength is rising again and it peaks as high as it did before. But as it leaves 180° it fades away for the second time, and at 270° it reaches its second fade-out point.

This is the classic "figure eight" pattern, where the waist represents the area of weakest or no signal, and the top and bottom of the eight are the reception peaks.

If you try this with a handheld transistor receiver tuned to a local broadcasting station, using its internal ferrite rod aerial, you will find it hard to decide — over quite a few degrees — where the signal peaks. On the other hand, the weakest or "null" points are much sharper and easier to pinpoint accurately.

So one of the tricks in DFing is to tune to the null, and then say your station lies on a line 90° or 270° to the direction the aerial is pointing.

However, standing on a deck heaving up and down in mid-Tasman, mid-Australian Bight or somewhere in the Indian Ocean, and pointing vaguely in one direction and its reciprocal still doesn't tell you where you are, other than that you are somewhere between the Antarctic and Adelaide.

Note one point: you need to know what the station is you are receiving, to know where you are pointing. For this, you need a publication listing the broadcast stations, their frequencies and locations. The state offices of the DoTC can help here.

The classic DF situation is to take bearings of three different transmitters, roughly 120° apart if you can find three so conveniently spaced. Work out the bearing from the station, and rule pencil lines on your chart.

With the perversity of Murphy, small babies and wom...er, wombats, (no chauvinism here!), the three lines will never intersect. Human experience covering some 70 years of navigation using radio

A steal at $149: Dick Smith Electronics direction-finding receiver. It would have to be one of the most under-promoted, least appreciated marine electronics products on the market. It tunes to medium frequency and VHF broadcasting bands (AM and FM); CB (26.4 to 27.45 MHz); shortwave (3.9 to 12.5 MHz); and VHF bands (59 to 218 MHz). Cat. D-2832.

DF suggests that if those lines did intersect at one point there would be something rotten in the State of Denmark, or the state of the DF gear/operator. Instead, your lines create a triangle, the classic "cocked hat" of DF.

But if you've done it right, you are usually in the middle of the cocked hat. Experienced operators can be heard to remark how surprisingly accurate this point usually is.

A word to the wise: do not wait until you are dismasted, riding out a gale somewhere off the Kimberleys before you try some DFing!

Begin with a session out in the back garden; getting the knack of tuning in a station, swinging the aerial and seeking the null. Plot bearings from the local radio stations to see how well it works. By the time you are accurate enough to plot your position as a few metres down the road in the local pub instead of two suburbs away, you are ready to try the system out at sea.

This requires you to stop quaffing the foaming nut-brown while contemplating the ravages of anorexia on the bodies sunning themselves on the beach and discipline yourself to taking bearings while keeping the craft on a steady course, so as not to disrupt the readings.

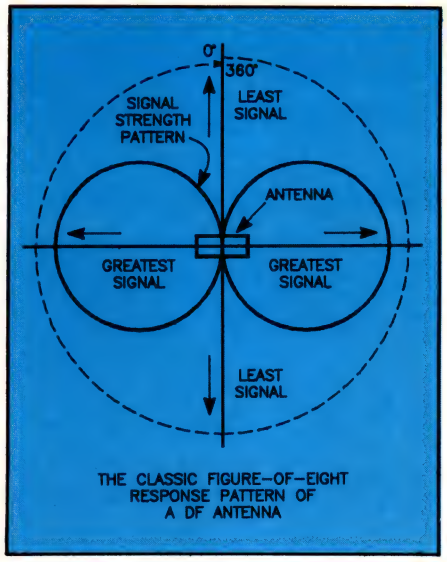
The final steps are to practise when at sea, so as to introduce a new set of radio stations and angles, and in rough conditions while you are tossing about all over the place. DFing under these conditions separates the serious navigator from the "out the heads and down to Bondi" playboys.

At this point, we can widen the discussion by saying there are error-producing parameters in DF. First off, here's "night effect", which has nothing to do with darkness making it hard to see anything. Rather, it is about skywave reception increasing at night. That means that what with bouncing around between the ionosphere and the sea/earth like a tennis ball at Wimbledon, radio waves arriving on a certain bearing don't necessarily mean that they started off exactly from that bearing. So if "Oyles ain't oyles" in TV adverts, "bearings ain't necessarily bearings" in nightime DF.

During the day, reception from skywave for medium frequencies (broadcast band) is not of much consequence for up to 160 km, and sometimes more, over the sea. So bearings accurate to ± 2° should be possible. But at night the skywave becomes more important — although less so over sea than over land — and the reliable range for accurate bearings comes down to about 40 km or so.

Also, within an hour of each side of sunrise and sunset, when the ionosphere is changing, reliable bearings are most unlikely, with errors possibly up to 30° off.

During the day, on shortwave frequencies, most reception is skywave and subject to "night effect" error.



THE CLASSIC FIGURE-OF-EIGHT RESPONSE PATTERN OF A DF ANTENNA

Also, remember that your bearings are great circle ones. This may not mean much in the Tasman Sea, but it could if you were halfway to South Africa or South America, but you're unlikely to receive broadcast stations there.

Now try "coastal deviation," or "shore error". This is where the radio wave's path is distorted by perhaps passing over the coast. If the radio wave, on its way to your craft, crosses the coast at an angle of 20° or more its direction of travel is appreciably altered. This is more likely to happen where there is high land between the transmitter and the coast. The wave might be reflected from land near you, or from high land behind the transmitter.

The point is to be aware of these causes of error, which will allow you to decide what value you place on your different bearings.

The radio transmissions may also pass over land rich in iron ore, increasing the error. The Norwegian coast is noted for this one, so stick to sailing around Australia and if you must go to Norway via the Atlantic do it by plane.

There is "quadrantal error", where metal in the boat may deflect an incoming radio signal. This is a significant problem in big, steel ships, but less likely in a small fibre, wood or concrete craft. However, the mast and possibly the motor might affect some bearings. You can test this by swing the craft around 360° at anchor, taking bearings on DF and correlating with a bearing on a fixed point on land. In a big steel ship a calibration curve can be established, but this is not likely to be needed for an ocean-going yacht.

Practicalities

Thus, studying radio DF is like studying the birth of human beings: there are so many things to go wrong the student wonders how anyone manages to survive from conception to arrival in one piece. The fact that so many make it, however, shows just what can be done when Nature really tries, and similarly, radio DF is highly effective within its limitations: provided you are aware of them, and know when to take them into account.

You would not, for example, enter the Brisbane River in a 2 m visibility fog at midnight after the moon has set, using DF. If you didn't have radar, you would anchor and wait for daylight. For one thing, you wouldn't be able to take and plot DF bearings fast enough.

But consider yourself at sea somewhere off Sydney, in a small craft without satellite, Omega or Loran navigation. A storm rages for three days. After it's blown out, you claw up into the cockpit to find you are dismasted, the motor is flooded and nothing works. Without generator power you cannot use RT. You might be off the coast of South America for all you know.

Well, retrieving your DSE DF receiver from below where you had been filling in the time between weather reports listening to mind-improving ABC programmes as you rode out the storm, you tune in a station, as strong as you can find. From its frequency you consult the list of stations and decide it isn't Perth or Daly Waters, but more likely Rockhampton or Eden in NSW.

Take 567 kHZ. There are 6MN at Mt Newman in Western Australia, 4JK at Julia Creek in Queensland, and 2BH at Broken Hill in NSW on this frequency. But do not overlook the powerful, 100 kW transmitter of 2YA in Wellington, New Zealand. If you are not careful, you might take your bearings on 2YA and think it was the reciprocal of one of the Australian stations.

Keep listening. If you don't hear a callsign, you will get some indication which says you are tuned into NSW or Queensland. Such as when the news broadcasts talk of "the Prime Minister, Mr Lange," you can be pretty sure you aren't listening to an Australian station. News broadcasts with local news, or advertisements naming adjacent places should give you the clue.

Actually Auckland, Christchurch and Dunedin have 20 kW stations at the low end of the medium frequency band which, along with 4YZ Invercargill, are easily received on the eastern coast of Australia at night. If you can pick any of these during daytime — or any New Zealand stations, for that matter — they will give you greater angles to get a better bearing than if you were DFing Australia alone. The Cook Islands, Norfolk, and Fiji and others all have broadcasting stations, so you need a list of Oceania broadcasters as well as Australian and New Zealand stations if you are messing about in boats in that part of the Pacific.

OK. Swing the aerial for a null. If the receiver is lined up fore and aft with your craft, you swing the DF receiver's com-

• to page 30. ▷

Equipment this year shows more sophistication

Ben Furby

While new craft are in seeming abundance this year, there has not been much forthcoming on new releases of marine electronic equipment. But what there was shows an increasing level of sophistication as a result of the march of electronics technology.

Furuno's latest colour video sounder, the FCV-140, features a multiple "window" display with independent setting of the sounding parameters within each window.

Furuno's impressive '88 equipment line-up

Among the new range of computerised units from international marine instrument specialist Furuno is an ultra compact, full-featured radar, the model 1720, said to be suitable for small boats, particularly yachts.

This supplements the larger radars for tugs, trawlers or large pleasure cruisers under 10 000 grt. These radars, the FR1500 series rasterscan radars, use multi-level quantisation of incoming echoes on eight levels to produce detailed and accurate representations of targets. The GD-180 colour video plotter automatically plots the vessel's track and has other aids to ensure safe passage.

Then there is the compact Furuno Felcom 5 inmarsat ship-earth station to provide versatile communication.

Bridge watchkeepers can be relieved from continuous operations while the vessel is kept automatically on course by the FAP-50 microprocessor-controlled multifunction autopilot.

For the professional fisherman, the FCV-140 video sounder and net recorder CN-8, provide up-to-the minute screen presentation and instrument readings.

The FCV-140's 36 cm screen allows either a 16-or eight-colour presentation of target echo strength which may be chosen to depict clearly what's going on below. Change the background colour between dark blue for night-time and light blue for daytime. Brilliance is controlled in four steps to match any ambient light.

The basic range is up to 3000 m, with phasing down to 5000 m.

The unit claims to be versatile. It can show four independent display windows with any combination of external sources the operator wants.

For example, you could display simultaneously in on-screen windows a deep water, slowly advancing sounding looking for bottom contour, together with a high speed short range sonar picture looking for baitfish, plus a vertical sounding set to see deeper mid-water fish, and a netsounder showing fish entering the ne

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□ Marine □ Land/Mobile
to: .....
.....
.....

Each of these windows can be set up with different advance speeds and different range settings.

You might want to display the history of surface water temperature plotted across the screen, and there is a special Fish Density quantity assessment function to show the relative echo abundance within an area.

Another video unit, the GD-180, is a colour video plotter. This automatically plots the track of a vessel on a high resolution 30 cm colour screen. It was designed specially for non-glare operation. Navigation input can be accepted from various devices such as Loran-C receivers, satellite navigators, GPs, hybrid Satnav/Omega/Loran or Decca systems.

The unit has a built-in floppy disk drive for storing track plots for future trips, or for overlaying electronic charts as they become available.

These instruments are distributed by J.N. Taylor & Co., which also distributes Stowe "Navigator" logs, sounders and wind monitors. These are said to be suitable for racing and cruising yachts, and power boats. A new series, the Power 200 and 210 digital log and sounder, has been designed specifically for power craft of all types.

Contact J.N. Taylor by phoning **(008) 22 6413.**

Handheld transceiver with the 'smarts'

Signalling its landfall at Australian ports is the Icom IC-M11, a new handheld VHF marine transceiver specially engineered for emergencies.

The transceiver is splash-resistant, with dust-proof rubber seals on all casings and switches, strong front and rear frames and an operational temperature range able to cope with extremes from the Antarctic to a tropical summer.

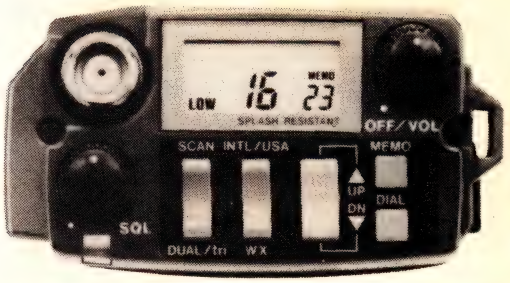
It is pre-programmed with all possible VHF marine channels for immediate use in any port worldwide. The 24 user-programmable memories can store your preferred operating frequencies at the touch of a button, or memories can be cleared and rewritten in moments.

The receiver is said to be highly sensitive for picking up weak signals, while the transmitter emits a full 5 W as permitted by the Australian licensing authority, the Department of Transport and Communications.

Features that have particular interest are the dual-watch and tri-watch functions. This enables you to monitor two or three channels simultaneously: distress channel 16 and any other two channels. The transceiver also has multiple scan modes: *dial scan* for all-channel monitoring; *memory scan* to monitor only the 24 user memories.

The IC-M11 has top-mounted controls. Together with its large and clear LCD digital readout, this makes it ideal for belt mounting. It weighs 675 g, and its "power save" feature enables longer operating time between charges. Icom said the unit had been type approved by the Department of Transport and Communications.

The distributor is **Icom Australia, 7 Duke St, Windsor, Vic 3181.**



Icom's newest marine handheld transceiver includes special features that allows you to keep watch on two or three channels: the emergency channel, ch. 16, and one or two other channels of your choice. The controls are well placed and the LCD digital readout easy to see.

Flush out those foxy fish

A 15 cm colour CRT echosounder, the Fuso MF603, claims extensive features. Probably the most innovative is *Bottom Lock*, which effectively reveals sea life at the bottom, according to Fuso. It can be set work in depths from 5 m to 100 m in 5 m steps.

Other features include: *Auto-shift*, which always positions the bottom range on the CRT without manual change; *Anti-clutter*, which merges the weaker echo levels to background so at to eliminate unwanted echoes; *Upper and Lower alarms*, showing the change in bottom contour within a range of 0-100 m; *Range slewing*, allowing you to move the range up or down in five unit steps at the push of a button; *Range Shift Selector*, auto or manual, with 5 m increments for manual and 15 m for automatic.

The Display offers three steps of picture speed plus a freeze mode using a black or blue background. In addition the unit includes *Memory Backup*, to preserve last-entered settings, and *Surface Water Temperature* from 0-40° C, along with digital display, fine echo control, positive echo control, bottom marker facility and bottom arrow, auto gain and auto range. Phew!

From the same maker is the MF310 Multifunction LCD Fishfinder, easy to operate and with a medium resolution display. Housed in a 156 x 154 x 73 mm rugged, splashproof case, it can be installed in open boats. Automatic bottom tracking and gain controls locate the seabed automatically.

The unit allows the operator to override the range and gain control automatically. Therefore the operator can expand any section between the surface and seabed to see features in more detail. Basic depths are 0-3, 6, 12, 25, 50, 100 m and with the shift function, increments of 1 m allow the range to expand to 200 m.

With three modes, you can choose: *Standard Display*, showing seabed and fish, with digital depth and surface temperature; *Digital Display*, showing depth ▷

and water temperature in large numerals; and *Fish Loupe* display to show fish activity directly below the transducer.

The MF403 LCD Echosounder claims a screen resolution approaching the resolution of a CRT. It is easy to read in sunlight and its construction suits open boat or flying bridge installations, the makers say. It has five shallow and five deep water ranges, which coupled with the shift function lets you zoom in on a certain depth level then show it on the full screen. Digital depth readout gives the change in bottom contour continuously.

That unit is complemented by the MF302 LCD Fishfinder. This one claims the latest in microtechnology, and is super lightweight at 500 g, and compact. It can be used in boats where size and weight previously made a fishfinder impractical.

Readings are switchable between metres or feet, and it has a variable keel alarm for 0-30 m in single unit steps, and can expand a "window" for more detail at the wanted depth.

The MF302's size, portability and waterproofing, plus the optional 10 hour capacity battery pack makes the echosounder ideal for small boats such as dinghies and inflatables, we're told.

Distributor **Greenwich Marine Electronics** is at **6 Frank st, Gladesville, 2111 NSW.**

☞ **SAILOR'S FRIEND, from page 27.**

pass rose away from the ship's head to point true north. You get your null, and then swing the aerial back exactly 90° and say that your station is bearing so many degrees.

Normally, you should have some idea of where the sun is, even if there is still some overcast, so you should know which is the true bearing and which is the reciprocal. The sun is mentioned because the worst possible case is assumed, where the compass has gone U/S or the mate drank the alcohol from it, in classic seafaring style. If you drank the alcohol from the compass you'd be in no state to take DF bearings anyway.

When you can get a third station from some other part of Australia, or Fiji or the Cook Islands, you can rule your own personal cocked hat. The only thing wrong with that is that you can't wear it, because it exists only on paper and not because you've got big-headed over your DF navigation prowess.

Wowie! You now know you are between 120 and 140 nautical miles from Newcastle, on roughly the same latitude.

Right! You now know that if you are going to head west, by how many degrees you should lay off or not lay off to make your home port at Sydney, Newcastle, Brisbane or whatever.

So you can get on salvaging the rigging and drying out the motor with some idea of what you face to return home.

Now note that you did not need elaborate transmitting gear, with CB too weak to get anywhere, VHF too far from other stations, and only a SW SSB set able to call up someone. You are listening to WWV for accurate time in lieu of a chronometer, and knowing your longitude to within a few nautical miles by DF you can verify that measurement and work it out more accurately from the sun.

Of course now you have worked out your position, you catch up with the news and enjoy music by tuning the DSE DF receiver into some entertaining programme.

Wrapping up

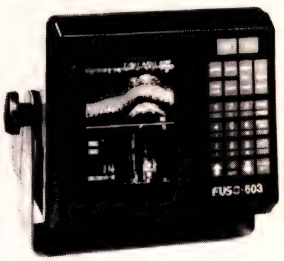
Such, then, is the potential of the DSE DF receiver. Perhaps I should mention that, in the more elaborate DF systems a "sense" facility is provided. This establishes which of the two bearings is the right one and which is the reciprocal. However, In a great many cases you would have had to be blown many hundreds of nautical miles off course before you were so disoriented you needed the sense facility to sort out the wood from the trees.

Happy DFing!

GME FUSO ECHO SOUNDERS LEADERS IN ECHO SOUNDER TECHNOLOGY

LCD FISH FINDERS

MF302 Compact. Ideal for Small Boats or Flybridge Mount.



COLOUR VIDEO SOUNDERS

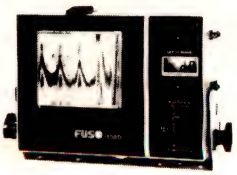
MF603 For the Serious Fisherman. 200 & 50KHz available.

MF310 Shallow & Deep Alarm. Large Digital Readout of Depth & Water Temperature.

MF402 Easy to use Fish Finder with Fish & Depth Alarm.

CHART SOUNDER

MF108D 4" Chart with Digital Depth Display.



MF403 High Resolution Display with Operator Programmed Zoom & Shift Functions.

MF25A Neon Flasher Depth Sounder with Alarm.

MF30A Digital Depth Sounder with Alarm.

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Fabulous prizes to win in our third birthday contest series!

What a haul! No matter what your interest in electronics, there's got to be several prizes in our great contest series to attract you.

OUR FIRST BIRTHDAY contest series proved extremely popular with readers. In five contests, we gave away six prizes worth over $6000. The contests ran over three issues and we got mountains of mail. We gave ourselves a few headaches judging it!

This year, for our third birthday, we're repeating the exercise – only we've got *more* prizes to give away – worth over $8000! How's that – it's *our* birthday and *we're* giving away the prizes! Eight firms have generously contributed equipment for the prizes: 3M, Dick Smith Electronics, Eagle Electronics, Elmeasco, K.C.C., Kenwood and Philips Scientific & Industrial. There's a total of ten products being given away in seven contest.

The contests this year are constructed in much the same manner as our 1st Birthday contest series. You have to answer a few pertinent questions on the prize, an "interesting" question on the prize's technology or technological background and then write us a little essay. Nothing too difficult there!

Enthusiast, engineer, captain or carpenter – get amongst this lot! You may enter any or all of the contests (hang it, go for broke!), and you may send as many entries as you wish. You can photocopy the contests, rather than cut your magazine, just provided you send an *original* page number of each contest with each entry, cut from an issue in which the particular contest appears. Give yourself more chances!

The prizes

Philips Scientific & Industrial Division donated a PM3050 50 MHz dual-trace oscilloscope for a prize in 1986 – and this year they're donating another! This time around its the upgraded 60 MHz model, PM3055. *And* they're throwing in a pair of 100 MHz x10 attenuator probes. This prize is worth around $2700. Fantastic! This CRO benefits from microprocessor control and has a number of unique features. It's ideal for general service and R&D work and is especially suited to working with video and TV equipment owing to its sophisticated timebase facilities.

Dick Smith Electronics has donated four of their great kits – so, if you're a dyed-in-the-wool enthusiast, you'll go for this. Their prizes are:

The K 6315 Teletext Decoder;
The K 6319 Teletext Tuner;
The K 4003 IR-remote Stereo Preamp;
The K 3437 1 GHz Frequency Counter;

The kits come with full instruction manuals and all parts, including the cases (except for the Teletext tuner, which installs inside the Teletext decoder). No doubt, as an enthusiast, you'll appreciate the utility of the 1 GHz Frequency Counter, while your family will appreciate the Teletext equipment and the IR-Remote Stereo Preamp. That lot should keep your weekends busy for a few months!

The Minnesota Mining and Manufacturing Co., better known as 3M, weighed-in with a static dissipative field service kit. Ideal if you're in servicing, or if you work with products or devices sensitive to static damage. Handy to have around, it could save you heaps, as well as saving heaps of hassles.

Elmeasco, the well-renowned instrument company, has *also* donated an oscilloscope – one from their Aaron range. This is the Model BS-601, worth $890, an ideal unit for general use – fault-finding, signal tracing, servicing, development work, etc. It features a component tester that can check both passives and semiconductors, giving an on-screen display characteristic of the device under test.

For the communications enthusiasts, Kenwood Electronics Australia donated one of their new wideband scanning receivers, the RZ-1. Sophisticated, but simple to use, it's a top performer that comes in such a tiny package it's ideal for mobile use, but acquits itself equally well as a "base" station monitoring receiver. It covers from the AM broadcast band through to 905 MHz, without break, and provides FM as well as AM reception. And we gave it an enthusiastic review in our June issue. This unit is worth over $1000!

Local mains filter manufacturer, K.C.C., has donated one of their top-line LF-4 "Squeeky Clean" Mains Filters. This features *four* filtered outlets and is ideal for keeping mains-borne "hash" from creating interference in communications receivers, etc, and keeping equipment- generated has from getting back down the mains. So, we've teamed it with the Kenwood RZ-1 so you can operate it from the mains, knowing you've eliminated sources of interference there.

And here's something for *everybody!* Eagle Electronics of Adelaide has donated an NEC Microwave Oven. We all have to eat! So, win this and you can spend less time slaving over a hot stove and more time slaving over a hot soldering iron!

Righto! Now, turn through the pages of this issue, seek out the contests and go to it! Who said it? – you've got to be in it to win it!

Rules

The contest is open to all persons normally resident in Australia or New Zealand, with the exception of the members or families of the staff of Australian Electronics Monthly, the printers, Offset Alpine, the companies donating prizes and/or associated companies.

Contestants must enter their names and addresses where indicated on each form. Photostats or clearly written copies will be accepted, but if sending copies you must cut out and include with each entry an original page number and month cut from the bottom of the page of the contest. This contest series is invalid in states where local laws prohibit entries. Entrants must sign the declaration, accompanying each contest, that they have read the above rules and agree to abide by their conditions.

The winning entry will be drawn by the Editor, whose decision is final; no correspondence will be entered into regarding the decision.

Winners will be notified by telegram the day the result is declared and the winner's name and contest results published in the next issue of the magazine in which it's possible to do so.

Send all entries to:
AEM Third Birthday Contests
1st Floor, 347 Darling Street
BALMAIN 2041 NSW.

CONTESTS CLOSE 31 OCT. 1988

Tannoy's "Little Gold" monitors

Roger Harrison

Tannoy has enjoyed a well-deserved reputation for its range of dual-concentric drivers for many years, its "Gold Monitors" creating something of a legend. Tannoy's star faded a little in recent years in the flurry of new loudspeaker developments, but with their new range of speakers winning accolades the world over, it seems a strong comeback is well under way.

A VERY GOOD FRIEND some years ago purchased a pair of Tannoy 15-inch Gold Monitor series dual-concentric drivers and built them into a substantial Bailey transmission line enclosure (described in *Wireless World* in the early-70s). He has a passion for organ music, among other things, and these speakers produced an *exciting* deep bass. He is also fond of jazz, classical and some chamber music.

Over numerous listening sessions with a wide variety of such music, I came to appreciate the superb stereo imaging that dual-concentric drivers offer, amongst the other attributes of these Tannoys. I, or should I say we, also came to appreciate the attributes of Tyrell's Long Flat Red and Penfold's Grange Hermitage, but as this is an audio review we'll leave their attributes for your own investigation.

If you've never encountered dual-concentric drivers before, let me briefly explain. Two drivers, one low frequency unit and one very much smaller high frequency unit, are mounted with the smaller unit *inside* the centre section of the low frequency driver and *on the same axis.* Both drivers share a common magnet assembly which, as you'd expect, is rather more complex than that of a conventional driver, but they have *separate voice coils.*

Hence, you have two drivers with concentric axes. The central dust cover of the low frequency driver is an acoustically transparent material over the operating range of the high frequency driver. While they share similar constraints with any other two-way loudspeaker system, as you would appreciate, dual-concentric drivers have an advantage in stereo imaging, particularly in the important crossover region, which is usually in the mid-range band between 1 kHz and 3 kHz. Tannoy have long been acknowledged as "masters" at dual-concentric driver design, and deservedly so.

For those unfamiliar with the brand name, and for those whose memory needs some refreshment, Tannoy is a UK-based company which has, for some 60 years, specialised in the design and manufacture of high quality studio monitors and loudspeakers. For a period in recent history it was owned by the US firm JBL, also a loudspeaker manufacturer.

About seven years ago a management buyout returned Tannoy to British control and they merged last year with two small British loudspeaker manufacturers: Morduant-Short, who produce hi-fi speakers, and Goodmans, who now produce speakers for the car sound market.

In January this year, they listed on the London stock market and the offering was over-subscribed. Renewed design effort has resulted in a flock of new releases since last year and to continue the pace, Tannoy has doubled its engineering staff in the past 12 months.

Recent times

So much for the halcyon days and legends of yesteryear. While Tannoy stopped producing the 15-inch Gold Monitor monsters some time ago, they have since developed a variety of dual-concentric drivers which they have employed in a series of loudspeakers marketed over recent years. One particular model that gained a substantial reputation and a following over the past few years, particularly in sound recording studios, was the Little Red Monitor, one of Tannoy's "SRM" (for Super Red Monitor) series of speakers which employed a phase aligned design bass reflex system.

Earlier this year I was fortunate to be able to talk with David Bishop-Powell o Tannoy during a visit he made here. He outlined the company's recent history and we talked about the SRM series and their newly-released successor, the Little Gold Monitor (LGM). Experience with the SRM series over the years threw up weaknesses of the system in a number o areas, particularly in the crossover construction, manufacturing techniques and driver characteristics.

The LGMs

The Little Gold Monitors are one produc from the new Super Gold Monitor (SGM series which succeed the SRM series speakers but bear little external change from the SRMs for those familiar with them or fortunate enough to own one They appear like "traditional" small speakers with a rectangular wood-grain cabinet, plain front grille and front-facing bass reflex port.

The LGM is a compact bass reflex system, the box measuring just 584 × 400 × 275 mm overall, yielding an internal volume a touch under 50 litres The cabinet is constructed of 18 mm high density particle board covered in real walnut veneer (not wood-grain vinyl) The cabinet is lined on the internal faces with an acoustic damping material. The grille is a single piece of "acoustically transparent" brown jersey fabric stretched over a wooden frame that pops onto the front baffle with small plastic fittings. All-up, each cabinet weights 21 kg.

A single dual-concentric driver is mounted a little above centre on the front baffle. Beneath it are mounted two panels with special switches that permit control of the high frequency rolloff and tweeter level. The plastic bass reflex port is mounted in the corner of the front baffle above the driver. The rear baffle contains an inset connector panel with screw terminals that will accept wire, pin or spade lug terminations.

The specifications give a "recommended amplifier power" rating of 10-200 watts per channel, a useful parameter for prospective purchasers. Peak power handling is given as 350 W. The LGM have a nominal impedance of 8 Ohms with a minimum quoted impedance of 5.5 Ohms. Sensitivity is given as 95 dB "domestic" (whatever that means), and 92 dB

nder anechoic conditions.

Tannoy claim the frequency response f the LGMs is 55 Hz to 20 kHz, within ±4 dB, and dispersion of 90° conical at 0 kHz. Both figures are quite respectable.

It's when we get to the crossover that hings get interesting. Tannoy say that the acoustic source" of the drive units is time aligned" by a special circuit they've ubbed the *SyncSource* time delay net-vork. SyncSource is a Tannoy trademark ame. The information supplied says the rossover type is an ". . . overdamped sec-nd order low pass coupled with first or-er high pass filters," with "parallel im-edance compensation together with yncSource second order all pass passive elay network."

The special switches mentioned earlier omprise a five-position treble energy at-enuator for level setting of the tweeter, nd a four-position roll-off slope switch. he switches consist of knurled screw-in olts that short contacts which select the equired circuit elements. They are ıounted on the rear of a board secured ehind the front panel, the crossover omponents being mounted on the other .de.

David Bishop-Powell told me that Tan-oy adopted hard-wiring of the cross-vers as experience showed pc board construction did not perform as well. Multiple earth paths are reduced to a common point star connection and dissimilar metal contacts have been eliminated, they say. The crossovers are manufactured using semi-robotic technology in order to maintain consistency in performance.

A taste of honey

We drove the LGMs with a 100 watt per channel amp, using a variety of material at a wide range of levels. Unquestionably, they have superb stereo imaging. The sound stage is precisely controlled, all the sources being readily identifiable, regardless of the pitch range.

There was plenty of bass, smooth and well controlled, but initially, the top end was found a little wanting. Some experimentation with the rolloff and treble energy switches soon cured that. The rolloff definitely sounded better set flat, while the treble energy switch had to be set to give a lift of several dB to give satisfactory results. This is probably an artefact of the listening environment and top marks to Tannoy for the inclusion of this facility.

Being relatively sensitive speakers, they did not require much driving. The LGMs sounded equally good at relatively low levels as well as with the wick wound up.

The LGMs did well on a variety of classical, pop and blues recordings used for this review. On small ensembles or with instrumental solos, the LGMs place the performers uncannily in the room with you. The "Mannish Boy" track from Muddy Waters' *Hard Again* album was so realistic it raised the hair on the back of my neck — drums, guitars, harmonica, Muddy and Johnny Winters were right *there* in the room!

Careful listening showed no apparent evils in the frequency response or polar pattern for that matter; their dispersion is very good, quite free of the "lobing" apparent on some multi-way design loudspeakers I've heard.

A quick check with an impedance bridge confirmed the general details of the impedance versus frequency response of the LGMs, with a peak a little below 100 Hz and a broad hump between 1 kHz and 5 kHz, dipping to around 7-8 Ω at other points.

The Little Gold Monitors certainly produce an exciting sound, admittedly without the deep bass of the 15-inch monsters mentioned at the head of this review, but a respectable performance for their size in any case. They will perform very well in a small room but have equal capacity to "fill" a large room too. Listen to them — it might be a hair-raising experience!

Review units kindly supplied by Hi-Phon Distributors, Unit 1, 356A-358 Eastern Valley Way, Chatswood 2067 NSW. (02)417 7088.

Can you spot the eight features on this scope that you won't find on most low cost 20MHz scopes?

Checking the specs on low cost scopes can get a bit repetitive - Yes, they all have 20MHz bandwidth and Yes, they've all got 6" rectangular screens. Some have1mV max sensitivity. So what's different about the New Goldstar OS7020?

1. Variable Sweep Control incorporating x10 Magnifier

Simply adjust the sweep to give a suitable trace then pull control for a x10 magnified image.

2.Uncal Warning Lights

When the timebase or input controls are not in their calibrated positions you'll see a warning light - handy if you're taking measurements.

3.Triggered LED

If the input level is sufficient to trigger the OS7020, then this LED is illuminated. Saves a lot of time fiddling when you're not certain that you've got proper triggering.

4. TV-V & TV-H Triggering

These switches are a further aid to triggering and are particulrly useful for the TV service technician.

5. Trigger Hold-Off

Another aid to triggering - use this control to delay the sweep on complex waveforms

6. Professional Tilt Handle.

Many manufacturers take a short cut and give you a cheap carry strap. Not so on the Goldstar OS7020; you get a professional multi-position tilt handle.

7. 1mV maximum Sensitivity

Use the built-in x5 magnifier to get 1mV/div maximum sensitivity.

8. Made by GoldStar

Your guarantee of quality. The OS7020 is designed and built in Goldstar's own factory. Many of the parts are specially made by GoldStar. That's why we can offer a *one year warranty* and extra features at no extra cost!

Also enquire about the OS7040 scope.
40MHz/1mV with delayed sweep.
$1380 inc tax with 2 probes.
$1150 ex tax with 2 probes

Check these prices !

$888 ***inc tax complete with two high quality switchable probe kits***

$740 ex tax with probes

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Dealer enquiries welcome. Call (02)736 2243
Recommended prices only

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● Nortek (Townsville) (077) 79 8600
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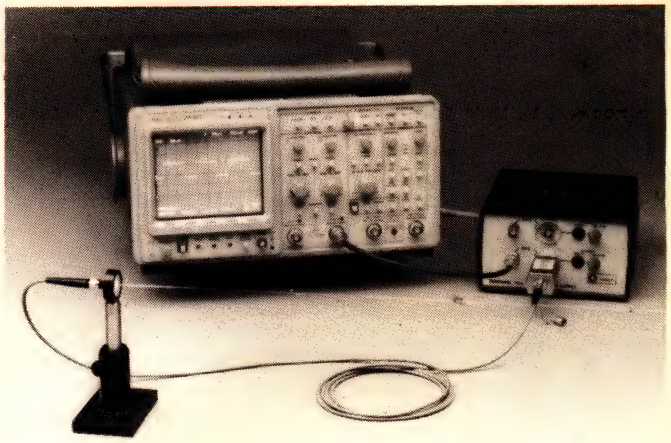
● J Blackwood & Sons 46 0391 ● Petro-Ject 363 1353
TASMANIA George Harvey (003) 31 6533 (002) 34 2233
VICTORIA Radio Parts 329 7888 ● George Brown Electronics Group 878 8111 ● G.B. Telespares 328 4301
● A.W.M. Electrical Wholesalers ● Petro-Ject 419 9377 ● J Blackwood & Sons 542 4321
● Factory Controls (052) 78 822 ● Mektronics Co 690 4593 ● Truscott Electronics 723 3094
W AUSTRALIA Atkins Carlyle 481 1233 ● Dobbie Instruments 276 8888 ● Protronics 362 1044

Optical systems testing with your oscilloscope



Any conventional oscilloscope can be used for measuring optical signals with Tektronix' new 1103 Tekprobe power supply adapter in conjunction with their P6701/02 optical/electrical converters.

The 1103 Tekprobe enables optical power measurements, rise time, aberration, bandwidth, dynamic range or noise equivalent power of components or systems.

The 1103 adapter, when used as part of a system, enables all oscilloscopes to measure calibrated optical signals, both fibre-based and free-space.

It sends calibrated voltage signals to the oscilloscope so users can make average and pulse optical measurements.

This unit also facilitates the simultaneous display of electrical and optical waveforms for characterisation of opto-electronic devices on dual-channel oscilloscopes.

Full details are available from **Tektronix, 80 Waterloo Rd, North Ryde, 2113 NSW. (02)888 7066.**

New dc-ac inverters to 15 kVA

Using pulse width modulation technology, inverters ranging from 500 VA to 15 kVA ensure distortion-free sine wave power for sensitive electronics equipment, according to distributor, Online Controls.

A 300 per cent highest current capacity eliminates any need for oversizing to meet load start-up surges. Digital system status monitoring provides clear, precise readings for critical power requirements.

All the inverters include Inston, which combined with a 1 ms static bypass transfer switch enables the inverters to operate in off-line or on-line mode. This adds flexibility and protects against battery or charger failure. or inverter failure.

Input voltages of 12, 24, 48 and 125 Vdc can be used with selectable outputs of 120 and 240 Vac at 50 or 60 Hz.

Contact **Online Controls, Unit 2/7 Waltham St, Artarmon, 2064 NSW. (02)436 1313.**

Improving solid state relays

By soldering the triac of their solid state relays to a tin plated bronze heatsink, Echowell Power claims to have enhanced the performance of its Power Series solid state relays.

The selected materials and soldering increase heat dissipation, they claim.

Other features claimed for the relays are low power consumption, TTL and CMOS compatibility, and opto-isolation.

They have 0 V turn-on, 0 A turn-off as standard but can be ordered in random-on versions for fast turn-on.

Input reverse voltage protection and snubber circuit protection give them high immunity to load transients, the makers say. A peak voltage turn-on version is for highly inductive loads.

For more information: **Multicorp, 35 Wells St, Redfern, 2016 NSW. (02)698 5238.**

Tape fault spotter

A colour CRT display shows information on magnetic and physical defects in tapes, while an opto-electronic edge detector physically evaluates prerecorded tapes.

Top of the Tapechek range is the model 6120, a high speed evaluator/cleaner for 1" tapes. This tester also uses 20-track "Micro-pulse" electronics to detect dropouts quickly and thoroughly.

Other checkers are for the ¾" U-matic (VT3100), the ½" VHS and M formats (VT2100) and the ½" Beta and Betacam (VT1100).

The VT series claims a fast, accurate four-channel detection system that spots and counts defects at 25 x standard play speed.

A sapphire burnisher polishes the tape while special cleaning tissues remove loose oxide, reducing dropouts. A LED display reports number of defects in each area plus total.

Contact **Trace Technology at 26A, 1 Short St, Chatswood, 2067 NSW. (02)417 7922.**

Use your PC as a CRO

Converting any IBM PC-compatible computer into a laboratory grade, dual-trace 50 MHz digital storage oscilloscope, the Heath/Zenith SC-4802 adds considerable versatility to the basic unit in engineering applications.

Software supplied provides full control of all scope functions from the computer keyboard, and all waveforms, measurements and menus are clearly displayed on the computer screen.

The software allows complicated test procedures to be carried out, such as averaging successive samples of a repetitive waveform to eliminate random noise riding on a signal.

Computer-generated cursors can be placed anywhere on displayed waveforms to provide simultaneous direct readouts of voltage differential, time differential and frequency. Waveforms saved on disk can be recalled to compare a "live" waveform with one previously measured. Up to two stored and two "live" waveforms can be displayed simultaneously.

Contact **Anitech at 1-5 Carter St, Lidcombe, 2141 NSW. (02)648 1711.**

GREAT READER OFFER!

HANDY 'POCKET' TESTERS

FEELING TESTY?

If so we have just the thing for you.

AEM, in conjunction with Aliette Pty. Ltd., are able to offer two incredibly useful and unbelievably priced test devices.

The PAMA Combi-Sensor

This unique device allows you to test whether or not a particular device or conductor is live, WITHOUT dismantling the device or stripping any wires. The Combi-Sensor is so sensitive it will detect voltages as low as 20 Volts.

It does this by detecting the associated field that is apparent when a voltage is applied to a conductor. The Combi-Sensor is as simple to use as your household torch, just place the end of the device near the object under scrutiny and press and hold the button on the top of the sensor. If a voltage, be it ac or dc, is present the Combi-Sensor will beep and an indicator LED will light.
What could be more simple?

A great buy at $34.95!

The TESTER PLUS

On first appearances the Tester Plus looks like a modern version of the neon screwdriver of old. However, DON'T judge a book by its cover!

The Tester Plus does everything its neon counterpart did AND MORE!

Not only can you check whether or not a power point is live, the Tester Plus is a ONE-PROBE continuity tester. To check, say, the continuity of a length of wire, all that is required is to hold the Tester Plus screwdriver with your thumb in contact with the metal plate on the side, touch one end of the wire with the tester's probe and the other end with your remaining hand. So easy even Uncle Fester can use it!

The Tester Plus has hundreds upon thousands of applications for the serviceman, enthusiast and professional alike. Battery and semiconductor testing, continuity check, voltage testing, automotive uses, repairing the boat – the list goes on!

How could you miss at $14.95!

AEM is acting as a clearing house for both the Combi-Sensor and the Tester Plus and we have been advised that there are a limited number of units available, *SO GET IN QUICK!*

Offer Closes 30 September 1988.

There are two quick, convenient ways to order one or both of these unique test instruments.

EITHER

Send the coupon with a cheque or money order, to:

AEM Testers Offer,
1st Floor, 347 Darling St.
BALMAIN 2041 NSW.

OR

'PLEDGE your PLASTIC'
by phoning (02)555 1677 during office hours and giving your credit card and address details.

PAMA COMBI-SENSOR

(PAT. PENDING)

MAIN FEATURES

- Solid state reliability
- Safe in use
- Simple in application. Used with equal ease by skilled electricians and housewives
- No test leads
- Handy and useful.

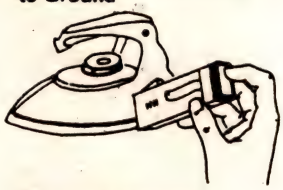
$34.95

Combi-Sensor is equipped with a test light and a sound emitting buzzer, and is operated by two standard AA batteries.

SOME OF THE SUGGESTED APPLICATIONS

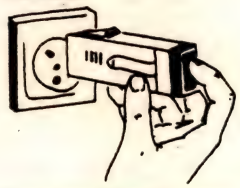
A – Detecting Live Conductors (Voltage Presence Test)
Press your Combi-Sensor slightly to the insulation of the tested conductor and push the button. If the tested conductor is live, Combi-Sensor will indicate it clearly by glowing test light and by continuous buzzing.

B – Testing Connection to Ground



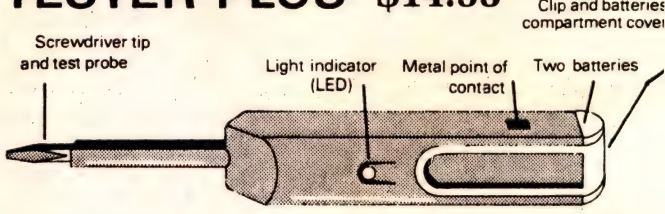
The tested electrical appliance should be switched on. Press your Combi-Sensor slightly to the appliance's surface and push the button. If the tested appliance is not grounded, Combi-Sensor will indicate it immediately by glowing test light and by continuous buzzer.

C – Wall Outlets and Switches



Press your Combi-Sensor slightly to the surface of the tested outlet or switch. Push the battery button. If the outlet or switch is live, Combi-Sensor will indicate it by continuous response of test light and buzzer.

TESTER PLUS $14.95



Yes, please send me the following quantities of the Combi-Sensor and/or the Tester Plus!

. . . . . Combi-Sensor(s) at $34.95 each.

. . . . . Tester Plus(s) at $14.95 each.

plus post and handling $3.00. per order.

I am paying by:

☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa

Cheque/Money Order No.:_____

Credit Card No.:_____

Signature:_____
(unsigned Credit Card orders cannot be accepted)

Name:_____

Address:_____

P/Code:_____

Phone No.: (___) _____

'Pro-grade' kits for educationists, industrialists and enthusiasts

A new Sydney-based company is developing a range of self-assembly kits for the educational, enthusiast and industrial markets.

Being developed and marketed by Australian Test & Measurements (AT&M), the kits will include a range of process control modules such as presettable multi-digit counters with LCD and LED readouts, digital voltmeters, various transducer conditioning modules for temperature, pressure, and pH, etc all using professional grade electronic components.

Built-it-yourself kits will include complete test equipment such as signal generators, oscilloscope digital storage adapters, power supplies and others.

A marketing campaign will begin in December with distributors appointed in all states and mail order sales from AT&M.

AT&M is headed by former Promark managing director Clive Chamberlain.

Contact the company at **25-27 Whiting St, Artarmon, 2064 NSW. (02)906 2333.**

Miniature mylar transducer

With a quoted frequency response of 500 Hz to 4 kHz, and a resonance of 1.25 kHz, a new miniature mylar cone speaker/transducer from IRH handles 100 mW with 200 mW at the most.

Its lowest sound pressure level output is quoted at 85 dB (A) at 100 m with a 1 kHz sine wave applied. The standard coil impedance is 8Ω with other impedances available to special order.

Dubbed the KSS 3108, the transducer operates at temperatures from -20 to 60°C, the makers claim.

Further information from **IRH Components, 32 Parramatta Rd, Lidcombe, 2141 NSW. (02)648 5455.**

N & D measuring

A new programmable high performance audio generator from, the model 5100, extends their model 5500 Programmable Audio Measurement System product line.

The 5500 is a fully automatic programmable system for measuring noise and distortion levels. The 5100 has the same specifications and an optional high level balanced output.

Further information from **Amber Technology, Cnr Skyline Place and Frenchs Forest Rd, Frenchs Forest, 2086 NSW. (02)975 1211.**

Order pc boards by post

Computer-aided pc board design, camera-ready artwork, pcb manufacturing and assembly, and module assembly on single-sided, double-sided and multi-layered boards is offered for clients throughout Australia from a firm in Cairn.

And all by mail!

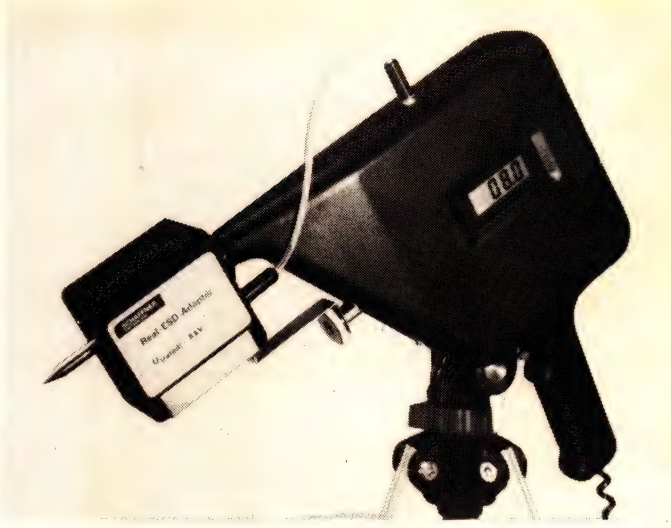
Inquiries to **The PCB Centre, P.O. Box 6136, Cairns Mail Centre, Cairns, Qld 4870. (070)55 4252.**

Professional S-VHS

Three S-VHS Euro System VCRs built to professional standards, and all peripheral equipment for full-scale video production, are offered by JVC.

The VCRs are the BR-S410E portable recorder for camcorder use; the BR-S610E as a standalone recorder or as a feeder in an editing system; and the full-function BR-S810E editing recorder.

The S-VHS Euro System is a unified standard for Europe, so that the S-VHS tapes can be played back on any S-VHS Euro System regardless of whether the original recorded signal was PAL or SECAM.



ESD tester

To meet the increasingly-stringent standards required in electrostatic discharge protection and testing, the new NSG 432 electrostatic discharge simulator from distributors Westinghouse Brake & Signal boasts a variable potential facility continually adjustable from 2 to 25 kV.

Using a multi-turn potentiometer to control the voltage, a liquid crystal readout improves setting accuracy. The high voltage modules available for this instrument are readily interchangeable for polarity choice and body models.

Adding a vacuum relay attachment allows current discharges with a rise time of less than 1 ns, meeting the latest proposals from the IEC Technical Committee.

The standard attachment kit includes an adapter for E field generation and a loop for the H test.

Contact Westinghouse Brake & Signal for details, at **80-86 Douglas Pde, Williamstown, 3016 Vic. (03)397 1033.**

New Siemens distributor

Siemens Electronic Components Division has appointed an additional distributor, Reserve Electronics Pty Ltd, to distribute the full Siemens range of electronic components throughout New South Wales.

Reserve Electronics, based in Perth, will be moving staff to Sydney to head up the new operation.

Latest line conditioners

The latest additions to the Topaz range of their Line 2 power conditioners include a 5 kVA, a 10P kVA and 15 kVA models, designed to provide "clean" power for computers and other sensitive electronic equipment.

Fluctuations as large as +15% to -20% of nominal line voltages can be regulated to within +4% to -6% and full correction is completed in less than 1.5 cycles, Topaz claim. Common-mode noise attenuation is claimed to be 120 dB.

These new Line 2 conditioners have circuitry that enables them to perform quick self-tests of status, greatly facilitating field service diagnosis.

Topaz also supply a range of smaller line conditioners rated at 500 VA, 1.2 kVA and 3 kVA, all part of a growing range.

Topaz equipment is supplied by **Online Control P/L, Unit 2, 7 Waltham St, Artarmon 2064 NSW. (02)436 1313.**

AEM 3520 RECEIVER KITS

Complete Kit With Crystal
(Please specify Desired Frequency)
$123 - 20 + $6 P & P

Additional Crystals $19 - 20 (+ $2 P & P if ordered seperatly)
The AEM3520 was designed by our Technical Director John Day
All our kits are supplied with professional grade components as speciffied in the design

BANKCARD , VISA , MASTERCARD WELCOME

Stewart Electronics
44 Stafford St
Huntingdale
P.O.Box 281
Oakleigh 3166
Phone (03) 543 3733
FAX (03) 543 7238

New storage oscilloscope

Tektronix has introduced an analogue/digital storage oscilloscope, the 2210, which combines waveform storage capabilities with a high bandwidth not previously available in a low-cost instrument.

The 2210 features 50 MHz analogue bandwidth, 20 MS/s (Megasamples/second) per channel sampling and 8-bit vertical resolution.

Waveforms can be viewed in the usual analogue oscilloscope mode, or they can be digitised and stored for easier viewing and comparison. The oscilloscope has excellent horizontal resolution (4k per channel record length).

Other features of the 2210 include: an external clock, adjustable from dc to 10 MHz; Pre/Post trigger, which displays conditions immediately prior to the trigger point; Post Acquisition Positioning, which allows the user to compare a captured waveform with a reference one; and magnification up to 50 times for detailed analysis of complex waveforms.

Applications include field and in-house servicing, including testing power supplies, TVs and VCRs, biomedical and medical research, electromechanical testing, and production test and process control.

For further information contact your local Tektronix office, or call **(02)888 7066.**

Automatic weather station

Complete and self-contained climatological recording is offered by the Feedback AWS522 automatic weather station from AWA.

The system continuously monitors windspeed and direction, air temperature, solar radiation, barometric pressure, relative humidity and surface wetness. A rainfall recording option is available.

The station is managed by a microprocessor-based control unit and combines complete flexibility with the extreme simplicity of unattended operation..It provides for the automatic recording of all data at regular intervals, together with the ability to interrogate any channel at any time.

The Feedback AWS522 is distributed by **AWA Distribution, Unit C, 2-8 Lyon Park Road, North Ryde 2113 NSW.**

Modular logic analyser

Tektronix has announced the release of their 1230 logic analyser, claimed to be the first such device offering modular design at a low cost.

Being of modular design, the 1230 can be configured with 16 to 64 acquisition channels – upgrades being accomplished by adding Tektronix's 1230E1 cards, which are easily installed by the user.

The 1230 logic analyser has four 2k *deep memories* behind each acquisition channel, which allows the comparison of any two memories. This allows the user to identify irregularities between data collected and data expected.

Triggering capabilities span the spectrum from basic to sophisticated requirements. In BASIC mode 14 levels of IF..THEN statement are available to identify triggering conditions.In ADVANCED mode the 14 levels are expanded to IF..THEN..ELSE, allowing branching in real time.

Microprocessors supported include the 68000, 68010, 8085, 8086, 8088, Z80, 6809 and more. The 1230 has up to four timebases, allowing the user to observe data from different parts of the system, each at the appropriate clock speed.

GPIB or RS-232 interface options are available, allowing interface to popular PCs or to clusters of GPIB instruments. An optional printer port is available for low-cost dot matrix output.

For further information contact **Tektronix Australia P/L, 80 Waterloo Rd, North Ryde 2113 NSW. (02)888 7066.**

High dielectric strength miniature relays

Potter & Brumfield (USA) have released the T84 series relays, which are a general purpose type designed specifically for telecommunications applications.

The dielectric strength between open contacts is 1000 Vrms and meets 1500 V FCC part 68 surge test. The T84 relays have a DIP terminal configuration which allows direct PC mounting or plugging into a 28 pin IC socket.

Standard or sensitive type coils are available in DC voltages from 3 to 48 volts. The standard type coils are available in either single coil non-latching or dual coil latching; the sensitive type coils are available either as single coil non-latching, single coil latching, or dual coil latching.

For further information contact **Tecnico Electronics, 11 Waltham St, Artarmon 2064 NSW. (02)439 2200.**

Capture those circuits with ESP

Parameters has recently aquired a new agency for a product known as ESP. It is described an intelligent circuit design capture tool; it comes from the UK and comprises a program that runs on an IBM PC/AT or equivalent.

A mouse or a puck is used for drawing and the software offers full colour and zoom capabilities.

Unlimited levels of hierarchy, automatic symbol status check, text location and the ability to handle multiple sheet schematics are just a few of its' key features.

It interfaces to most popular simulators and routers and could be integrated into an OEM product as the source code is available. Contact **Parameters Pty Ltd, P.O. Box 261, North Ryde 2113 NSW. (02)888 8777.**

Philips moves

Philips Components has moved its Victorian office to 23 Lakeside Dr, Tally Ho Technology Park, at Burwood East, 3151 Vic. General phone inquiries on (03)235 3677/66, and sales to (03)235 3680/1.

Philips said it moved to give better customer services from the heart of the electronics industry in Victoria.

Technico Electronics' Melbourne office has also moved to the same address, with the postal address P.O. Bag 30, Mt Waverley, 3149 Vic. Phones — (03)235 3685/6; Fax: (03)235 3688.

Stewart Catalogue update

Stewart Electronics of Melbourne now have available update No.3 to their catalogue. This update covers the complete range of Amidon ferromagnetic materials and J.W.Miller inductors for power and EMI suppression applications as well as types for RF and IF use.

Copies of Update 3 are available on request from **Stewart Electronics, PO Box 281, Oakleigh 3166 Vic. (03)543 7238**

Mylar capacitor alternative

Good frequency characteristics, low loss, low distortion and no piezoelectric effect are some of the features claimed by IRH components' new DD400 series of capacitors.

Suggested as an ideal replacement for polyester film capacitors in audio amplifier and similar equipment, the capacitors are available in 0.001 to 0.1 μF (that's 1n to 100n for the cogniscenti)on lead tape and ammo box for auto-insertion.

The DD400 series is a strontium titanate semiconductor capacitor of the boundary layer type, resulting in more compact size than conventional types, thus saving valuable pc board space.

The new capacitor uses paste printed and baked aluminium electrodes rather than the more usual silver, enhancing reliability by eliminating migration problems.

The distributors, IRH Components, can be contacted on **Sydney (02)648 5455, Melbourne (03)484 5021 or Perth (09)325 9333.**

Micron resolution plotters

Roland Australia has announced the release of their GRX series of A0 and A1 plotters, which boast a plotting resolution of 1.56 microns (0.00156 mm).

This accuracy is finer than the tip of any pen (by a long shot!), and should allow the drafting of a wide range of drawing with amazing accuracy.

The paper is held in position not only with the conventional etched track and grip wheel, but also by a series of vacuum suction grips, which minimise the tendency for the paper to billow and slip at high speeds.

The GRX series of plotters operate at 60 cm/sec, are HPGL II language compatible, and have both serial and parallel input ports. 18 kbytes of buffer memory is standard, and can be upgraded to one megabyte of buffer RAM.

Interface configuration characteristics can be selected through front-panel touch switches, rather than by internal DIP switches. The units carry eight self-capping pens, and feature "soft-pen landing" to reduce noise.

Contact your local Roland dealer for more information.

"Reading" your oscilloscope

Roger Harrison

Part 1

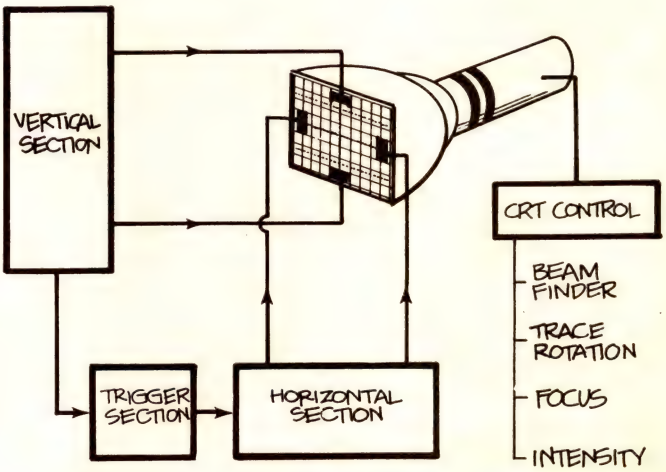
An oscilloscope front panel presents a profusion of controls, the operation of which, and the resulting display, often brings confusion. Here's a basic guide to what your instrument is trying to tell you.

AN OSCILLOSCOPE is undoubtedly one of the handiest instruments ever devised for electronic measurement and testing. It's a voltmeter, a signal tracer, an analyser and a frequency/period "measurer" all wrapped up in one convenient box.

To understand what the instrument is "telling" you when you've hooked up the probe or probes to a circuit you're investigating, you need to interpret not only the display on the screen but the control settings as well. So, let us first recap a few fundamentals of what an oscilloscope is all about.

The display system

The diagram at right shows the main sections or "blocks" of an oscilloscope; in this instance, it's a single-trace instrument, but multi-channel instruments simply have more of the same, and for this exercise, the same basic concepts apply. The oscilloscope draws a graph — a two dimensional representation - of the signal you apply to the vertical, or Y, input against time; the horizontal section providing the "timebase" — how often the spot is swept across the screen from left to right, the X axis. There is also a "Z" axis, which determines whether the spot on the cathode ray tube (CRT) screen is off or on, and its brightness when on.

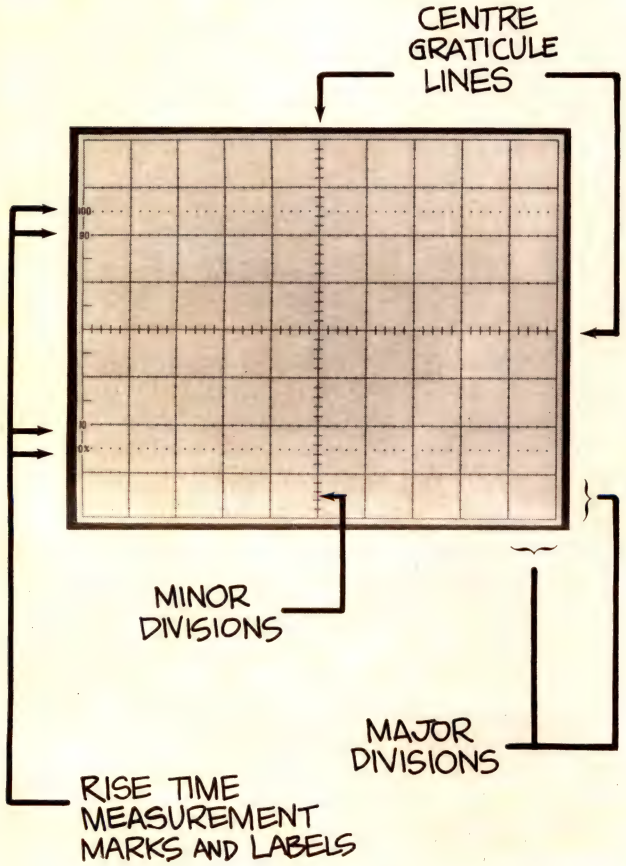


The display system of your CRO comprises the cathode ray tube (CRT) and its controls. To "draw" the graph of a signal being measured, the signal is applied to the vertical section, which supplies the Y axis, while the horizontal section sweeps the CRT trace across the screen — the X axis. A third axis, the Z, determines whether the trace is off or on, and its brightness when on.

Of primary importance in an oscilloscope's display system is the *graticule*, the grid of lines placed across the CRT's faceplate. This provides your primary reference when interpreting the display in either a quantitative or qualitative way. The graticule may be on the inside surface of the CRT, on the same plane as the trace drawn by the electron beam, or scored on a piece of transparent plastic placed over the CRT face on the outside.

A CRT with the graticule on the inside face eliminates *parallax* error when reading the display. Parallax error arises in this instance because the trace and the graticule are on different planes. If you view the display from an angle slightly off the direct line of sight, the trace will appear in a slightly different position.

Though different sized CRTs are found on different model oscilloscopes, the graticules are usually laid out in an 8 × 10 pattern. each of the eight vertical and ten horizontal lines denote *major divisions* of the screen, and these correspond to labelling ▷



The graticule on your CRO display provides the basic reference marks for reading the displayed waveform and taking measurements.

on the vertical and horizontal section controls which are calibrated in volts/div or seconds/div, respectively. The graticule may actually be ruled at centimetre intervals, and the controls calibrated in volts/cm or seconds/cm.

The "tick" marks on the centre graticule lines represent *minor divisions*, or subdivisions, of the screen. Some oscilloscopes also include marks to enable waveform *rise time* measurements, which are made at the 10% and 90% amplitude points, the 0% and 100% points being denoted by dotted or dashed horizontal rules.

These are all your basic reference marks when reading measurements from your CRO display.

Vertical and horizontal parameters

Assuming you know how to obtain a stable, usable display — from reading your instrument's handbook or perhaps *Using the Modern Oscilloscope*, by Roger Harrison and George Smith in the July 1985 issue of AEM, let us look at the role of the Y and X axis controls of primary importance.

Both the vertical and horizontal sections will have *position* controls. These are used to place the trace where you require it in relation to the graticule. When taking measurements or making comparisons, these two controls are first on your list in the setting up procedure.

Apart from the position knob, there are two other vertical controls of importance in taking measurements with a CRO: the *sensitivity* switch (may be designated as amplitude/div or volts/div, etc) and the *variable sensitivity* control (may be marked CAL. at maximum rotation). The sensitivity switch controls an attenuator in the Y section amplifier so that you can display a wide range of signal levels, ranging from millivolts to volts. Typically, it will provide steps of 1:2:5 ranging from, say, 1 mV at minimum to 5 V at maximum (1 mV, 2 mV, 5 mV, 10 mV, 20 mV, etc).

So, for example, when set on 20 mV, each major vertical division of the graticule represents an amplitude of 20 mV on any trace displayed. Thus, your CRT display is calibrated at 20 mV per division. Your vertical sensitivity control sets a *scale factor* for the display. Set to 1 mV/div, the entire screen can show 8 mV, or set to 5 V/div, it can show 40 V.

Two things can alter this scale factor: the probe you use, and the "vertical magnification" control, if your instrument has one. Using a "×10" probe changes the vertical scale factor by 10. If your vertical sensitivity control is set to 20 mV/div and you're using a ×10 probe, the vertical scale on your CRO's graticule is actually 200 mV/div and the whole screen can show 1.6 V (1600 mV), rather than 160 mV.

The variable sensitivity control is used when making pulse rise time measurements, but we'll get to that a little further on. It is also useful for making amplitude comparisons between signals or when adjusting a circuit. The display is uncalibrated when this control is in use and, for this reason, when ever you make actual amplitude measurements, it *must* be set to the CAL position (usually fully clockwise).

Some CROs have a *vertical magnification* switch that provides extra gain of ten times. This increases the vertical sensitivity scale factor by 10, so that if set to 20 mV/div, to take a familiar example, the graticule shows 2 mV/div and the whole screen 16 mV. Note that this will generally reduce the vertical section bandwidth by a substantial factor — often to a quarter or a fifth of the specified bandwidth. However, this may be usefully applied to reduce high frequency noise when taking readings on low frequency signals.

The main horizontal, or timebase, control is marked "sec/div" or perhaps "time/div". This control sets the horizontal scale factor, just as the vertical sensitivity sets the vertical scale factor. The range covered will depend on the bandwidth of the vertical section, but for typical low-cost CROs with a 20 MHz or 50 MHz bandwidth, this may be from 0.05 µs/div to 0.5 s/div, in 1:2:5 steps (viz: 1 ms, 2 ms, 5 ms, 10 ms, 20 ms, etc).

So, if set to 0.1 s (100 ms), the trace will sweep one major division of the graticule every tenth of a second, taking one second to sweep the width of the screen.

Besides the calibrated speeds, you can change any sweep speed by adjusting the variable sweep knob (sometimes marked CAL). This will slow the sweep speed by a factor of up to two or three, and the graticule divisions will not mean anything as set by the timebase switch. This control is useful when making comparison measurements and pulse mark/space ratio measurements, etc. We'll come to that later.

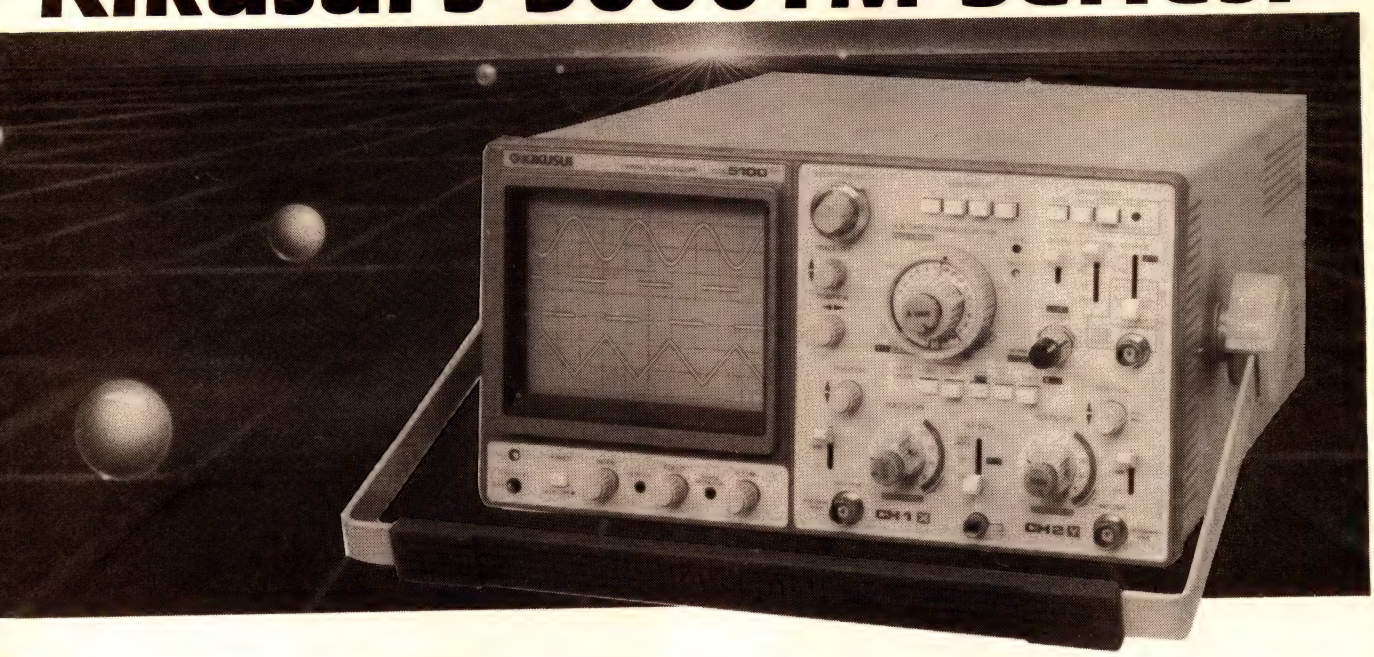
The timebase scale factor may also be changed by a "horizontal magnification" switch. This will, in general, provide a sweep speed magnification of 10 times, so that if the fastest sweep speed is 0.05 µs/div (50 ns/div), this will become a very fast five nanoseconds per division. Such a feature is useful for examining high speed signals or details in a signal that are close together. It is especially helpful in digital signal timing.

Bandwidth, probes and errors

The bandwidth specification of an oscilloscope's vertical channel, or channels, is based on the instrument's ability to reproduce sine waves. It is one of the prime specifications of any oscilloscope. Hence, you will see CROs advertised as a "20 MHz" instrument, or a 100 MHz instrument, etc.

The high frequency limit is the frequency at which a sine wave is reduced to 0.707 of the amplitude shown at lower frequencies, the -3 dB point. A CRO with a "50 MHz" bandwidth, having its vertical sensitivity set at 0.2 V/div, will display a 1 V amplitude 50 MHz sine wave over about 3½ divisions instead of five divisions. ▷

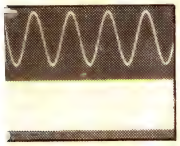
Kikusui's 5000TM Series.

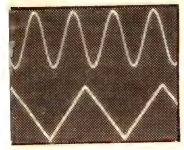


's the standard features hat make Kikusui CRO's xceptional.
he NEW COS-5000TM series ffers standard features, normally nly found on expensive, higher andwidth scopes.
onsider:

1 Bright and sharp signal traces with Automatic inear Focus. This eliminates the eed to readjust the focus during easurements between timebases. ven in high intensity, there are no looming effects.

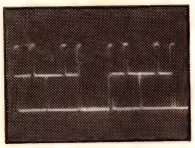
2 'Simultaneous' triggering of both CH1 and CH2.
he VERT MODE displays both signals whether they are synchronised r not. An indispensable facility hen troubleshooting between orking and faulty boards.



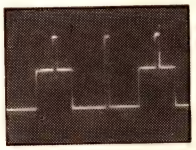


3 Auto setting of the optimum triggering level. In AUTO TRIG LEVEL LOCK, a peak to peak detector locks onto and tracks the trigger signal. There is no need to reset the trigger level between measurements.
The Manual Level Control provides superior triggering of complex waveforms or very low level signals.

4 Stable viewing of complex waveforms.
The VARIABLE HOLDOFF control allows the easy viewing of waveforms such as uP or video signals with multiple triggering edges, caused by different frequency and level components.



NO HOLDOFF



WITH HOLDOFF

5 Simultaneous display of original and magnified waveform. Kikusui's ALTERNATING SWEEP MODE allows both the original waveform and the selected magnified portion to be viewed simultaneously.

ORIGINAL

MAGNIFIED

6 Advanced new design using energy saving circuitry. The newly developed Dynamic Bias Circuit [PAT PEND] automatically controls the power consumption of the unit. Another feature in Kikusui's policy of continued innovation.

Features	5100TM	5060TM	5041TM	5021TM	5020TM
Bandwidth	100MHz	60MHz	40MHz	20MHz	20MHz
Channels	3	3	2	2	2
Vertical Sensitivity	1mV/DIV	1mV/DIV	1mV/DIV	1mV/DIV	1mV/DIV
Max Sweep Speed	2ns/DIV	5ns/DIV	20ns/DIV	20ns/DIV	20ns/DIV
Delayed Sweep	YES	YES	YES	YES	NO
Trigger Modes	CH1, CH2, VERT MODE, LINE, EXTERNAL.				
Alt. Sweep	YES	YES	NO	NO	NO
Delay Line	YES	YES	YES	NO	NO
Accel. Voltage	18kV	12kV	12kV	2.2kV	2.2kV
Warranty	2 YEAR WARRANTY ON PARTS AND LABOUR				
Probes	2 QUALITY SWITCHABLE PROBES INCLUDED				

For more information call Emona at **(02) 519-3933**, 86 Parramatta Road, Camperdown 2050. Or write Emona Instruments, P.O. Box K720, Haymarket, 2000. FAX: (02) 550-1378.

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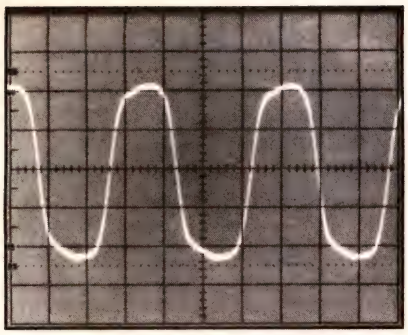
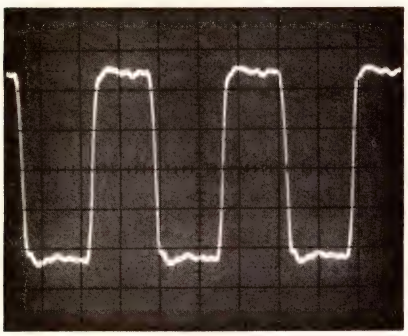
'THE TECHNOLOGY HOUSE'



15-MHz
Square wave on a
35 MHz
Oscilloscope



15-MHz
Square wave on a
50 MHz
Oscilloscope

Showing how the bandwidth of an oscilloscope can affect the appearance of a square wave signal, possibly affecting measurements and interpretation of the display.

But not all signals examined are sine waves. Square waves have substantial high frequency content in their rising and falling edges, and this will be attenuated as you approach the bandwidth limits of the instrument. In measuring the rise time of pulse or square wave signals (that is, the period it takes for the "leading" edge to reach 90% or full amplitude from the 10% level — explained more fully later), your oscilloscope's bandwidth and rise time response are important, else errors will creep in.

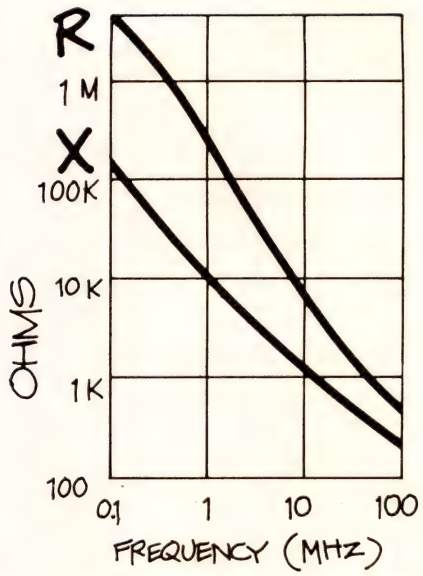
The frequency response of most oscilloscopes is designed with a constant that lets you relate the bandwidth and rise time of the instrument. This constant is 0.35, and you can relate a CRO's bandwidth and rise time using this approximation:

$$t_r = 350/\text{bandwidth (MHz)}$$

which gives the rise time in nanoseconds. A typical 50 MHz CRO will have a 7 ns rise time.

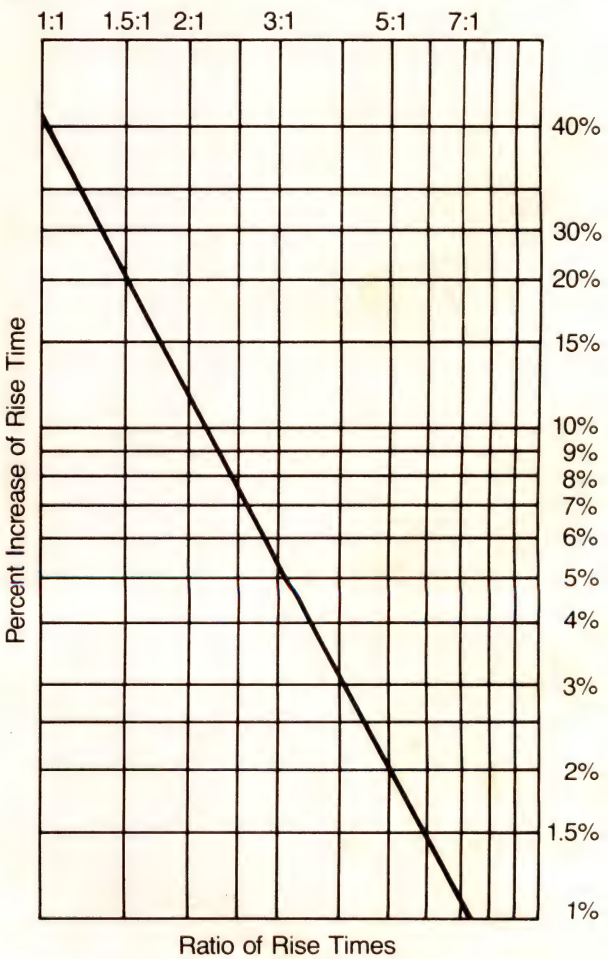
Rise time errors creep in as you approach the instrument's rise time. The percentage error depends on the ratio of the CRO rise time to the signal rise time. With a ratio of 5:1, you only get a 2% error; with a ratio of 3:1 the error's in excess of 10%. So, if you want a rise time accuracy of 2% or better, a 50 MHz CRO, with a rise time of 7 ns, may only be used where the signal rise time does not exceed 35 ns.

The probe you use may influence measurements, too. It can do this in two ways — by *loading* the circuit to which it's attached, and/or affecting the rise time (and of course, the bandwidth). Two probe configurations are commonly used: ×1 and ×10. The probe construction will necessarily exhibit resistance, capacitance and inductance, however small. For signal frequencies under five or 10 kHz, the most important loading component is resistance. To avoid circuit loading - that is, shunting a significant portion of signal current through the probe such that the circuit's own impedance causes a drop in signal voltage at the probe tip — the probe resistance must be more than 10 times, and preferably 100 times, the expected circuit impedance. A ×1 probe will have the same input resistance as the Y-input specification, generally 1 MΩ, so may be used where the circuit has an impedance under 100 Ohms. For circuits having an impedance in the range 100k to 1M, a ×10 probe having a 10 MΩ impedance is called for.



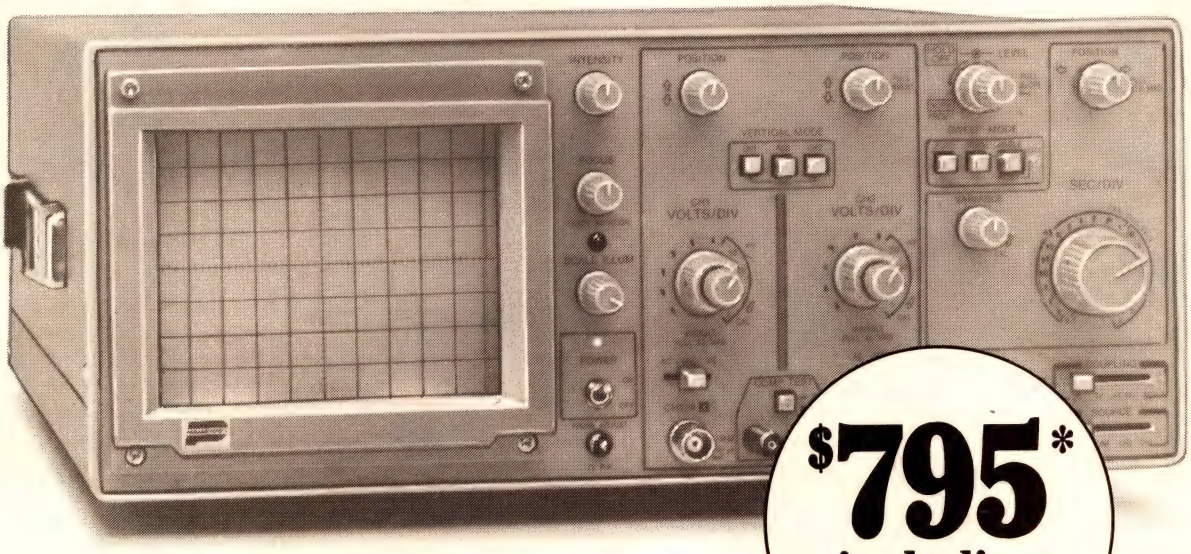
Probe impedance decreases with frequency, as shown here; a plot of a ×1 probe's resistance (R) and reactance (X) versus frequency.

When making measurements on circuits where high frequencies are involved, the probe inductance and capacitance become important. You can't help adding capacitance when making a measurement, but to keep it down, use a ×10 or other attenuator probe because of the length of screened cable employed on a ×1 probe it will add the most capacitance. Such



How rise time measurement errors are affected by the ratio of CRO rise time to signal rise time.

More MHz for your money



5502-20MHz

$795* including probes

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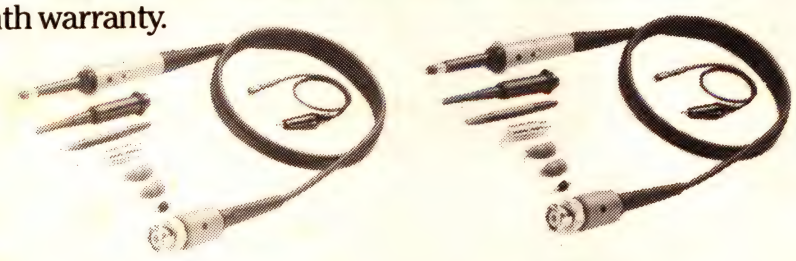
You'll also be glad to see that everything is included in the price – and that means the often elusive probes as well!

As with all Parameters products, these top-grade oscilloscopes are backed by our famous, non-nonsense 12-month warranty.



5502 – Unbeatable value in a 20MHz CRO

- 20MHz dual trace
- 1mV to 5 V/div
- Signal delay line
- Channel 1 signal output
- Variable hold-off
- Sweep magnification
- Trigger preset
- Single sweep
- 150mm rectangular CRT
- Illuminated inner-face graticule
- $795 including probes tax exempt

5504-40MHz for a 20MHz price

All the features of the 5502 with 40MHz bandwidth and delayed sweep. $1258 including probes, tax exempt.

5506-60MHz, 3 channel

All the features of the 5502 with 60MHz bandwidth and delayed sweep. $1675 including probes, tax exempt.

Prices are recommended only and don't include sales tax.

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PERFECTION IN MEASUREMENT

JBA 216

probes must be *compensated* to take into account their effect on square wave signals. Your instrument's manual shows how this is done, using the internal calibration signal.

The probe's *impedance* decreases with increasing frequency and will load a circuit unless the circuit's impedance is 10 to 100 times *lower* than the probe's impedance. This is particularly apparent with ×1 probes.

Probe bandwidth may affect overall bandwidth unless certain requirements are met. Don't assume that a 50 MHz probe and a 50 MHz CRO will give you 50 MHz measurement capability, it won't. Overall bandwidth will drop to about 35 MHz, and rise time will be about 10 ns instead of 7 ns. The combined rise times of the probe and the CRO is given by the square root of the sum of the squares of the individual rise times. The probe bandwidth has to be *at least twice* that of the oscilloscope, preferably more. Even a 100 MHz probe reduces the overall bandwidth of a 50 MHz CRO to 45 MHz and increases the overall rise time from 7 ns to just over 7.8 ns.

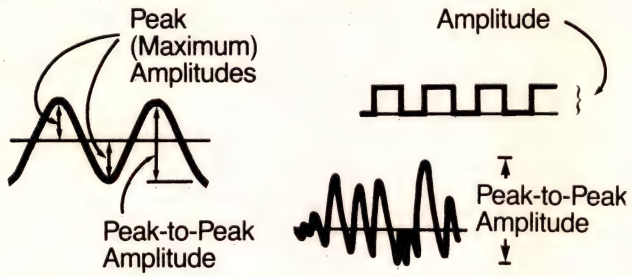
Remember, when measuring high frequency signals, the probe ground lead should be as short as possible. For really high speed instruments special probes are used.

Basic reading rules

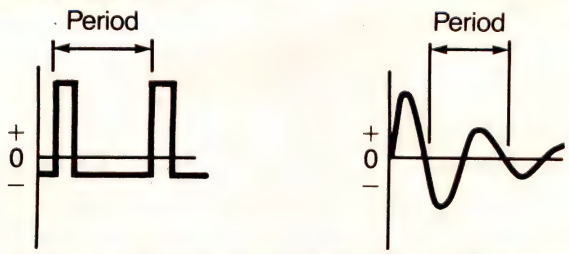
There are two basic readings or measurements you can make with an oscilloscope: amplitude and time. Almost every other measurement is based on one of these two fundamental quantities. Since a CRO is a voltage measuring device, signal voltage is shown as amplitude on the screen.

In making either amplitude or time measurements, the prime rule is to use as much screen area as possible. The more screen area you use, the better the measurement resolution. Use the centre vertical graticule scale for amplitude measurements and the centre horizontal graticule scale for time measurements; each has more graduations and less estimation is required.

When comparing two signals (using a dual-channel CRO) and measuring the difference(s), the same rules apply; use as much screen area as possible and line up the signals over the centre graticule scales to take readings.



Amplitude characteristics of a waveform are a measure of the signal's displacement compared with an established reference. In some instances, the overall amplitude is of importance; e.g: the peak-to-peak amplitude.



The period of a repetitive waveform is the time required for completion of one cycle, taken between points which are at the same place or position on successive cycles.

When making measurements where there's a dc component that's part of the signal, the above rules also apply, but the *zero* reference is established as a convenient horizontal graticule line.

For periodic, or repetitive waveforms — such as your 'garden-variety' sinewave or square waves etc, a period measurement is always made between two points which are at the *same place or position* on successive cycles.

Voltage and time measurements using your oscilloscope are *direct* measurements; you can also calculate *derived* measurements from these direct measurements of a signal's characteristics. For example, frequency is derived from the period measurement of a repetitive waveform; it is simply the reciprocal of period —

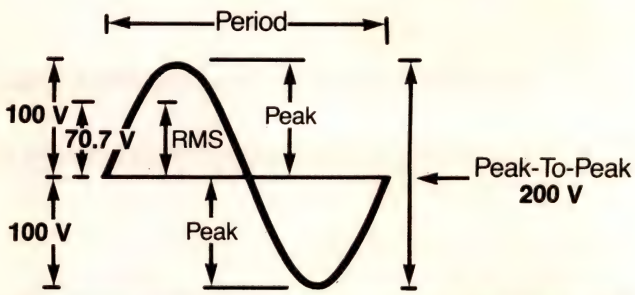
$$\text{frequency} = 1/\text{period}.$$

If the period is in seconds, the frequency will be in Hertz; if period is in milliseconds, frequency is in kilohertz; if period is in microseconds, frequency is in megahertz. Other derived measurements may be made also, particularly with regard to sine waves, which we'll deal with right now.

Reading your sines

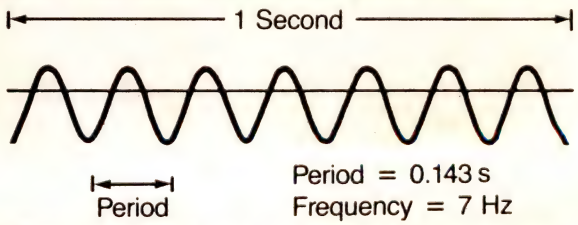
A sine wave is the simplest of waveforms encountered, and you can 'read' most of its characteristics using your oscilloscope, with the exception of distortion. The diagram here shows a sinewave and all its characteristics that may be determined using a CRO. The peak and peak-to-peak voltages (amplitude), and the period, may be measured directly. The RMS value may be derived from the peak voltage value as

$$\text{RMS volts} = 0.707 \times \text{peak volts}.$$



The characteristics of a sine wave (assuming no dc component is present) you can measure using your oscilloscope. The RMS voltage value is a derived measurement.

In measuring this signal, you would use a ×10 probe and the vertical sensitivity would be set on 5 V/div, giving an actual scale factor of 50 V/div on your graticule. Thus, the cycle displayed would occupy four major divisions on the screen. For one cycle displayed across the screen, if this were a 50 Hz signal, the timebase switch would be set on 2 ms/div, giving a period of 20 ms across the ten major graticule divisions.

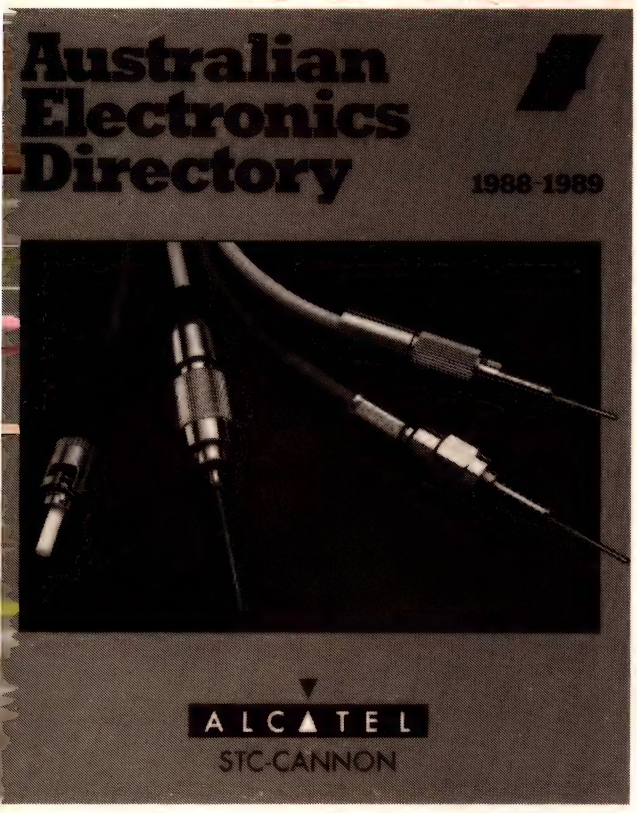


The frequency of a sine wave may be derived, as shown here, by displaying a number of cycles across the screen.

When deriving frequency from a period measurement, better accuracy is obtained by displaying a number of cycles on screen and measuring the overall period. The example here shows seven cycles of a sine wave; the frequency is thus seven times the reciprocal of the *total* period. Here, the total period is one second, so the frequency is seven Hertz. Display ten cycles and the frequency would be ten times the reciprocal of the total period — a convenient method to remember.

We gratefully acknowledge the assistance of Tektronix Australia for supplying material used in the preparation of this feature.

ELECTRONICS BUYERS GUIDE



The 20th Edition of the Australian Electronics Directory (Australia's only true directory to who's who in the electronics industry) has had many thousands of company information changes since last year including:— agencies and overseas principals represented, address, telephone, fax etc., along with management sales and technical staff.

There are also 124 additional product headings, including 2 new charts on SURFACE MOUNT TECHNOLOGY. The 5 major product categories covered in this unique directory are:
• Electronic Components • Construction Materials • Measurement & Test Equipment • Systems and Sub-Systems • Services.

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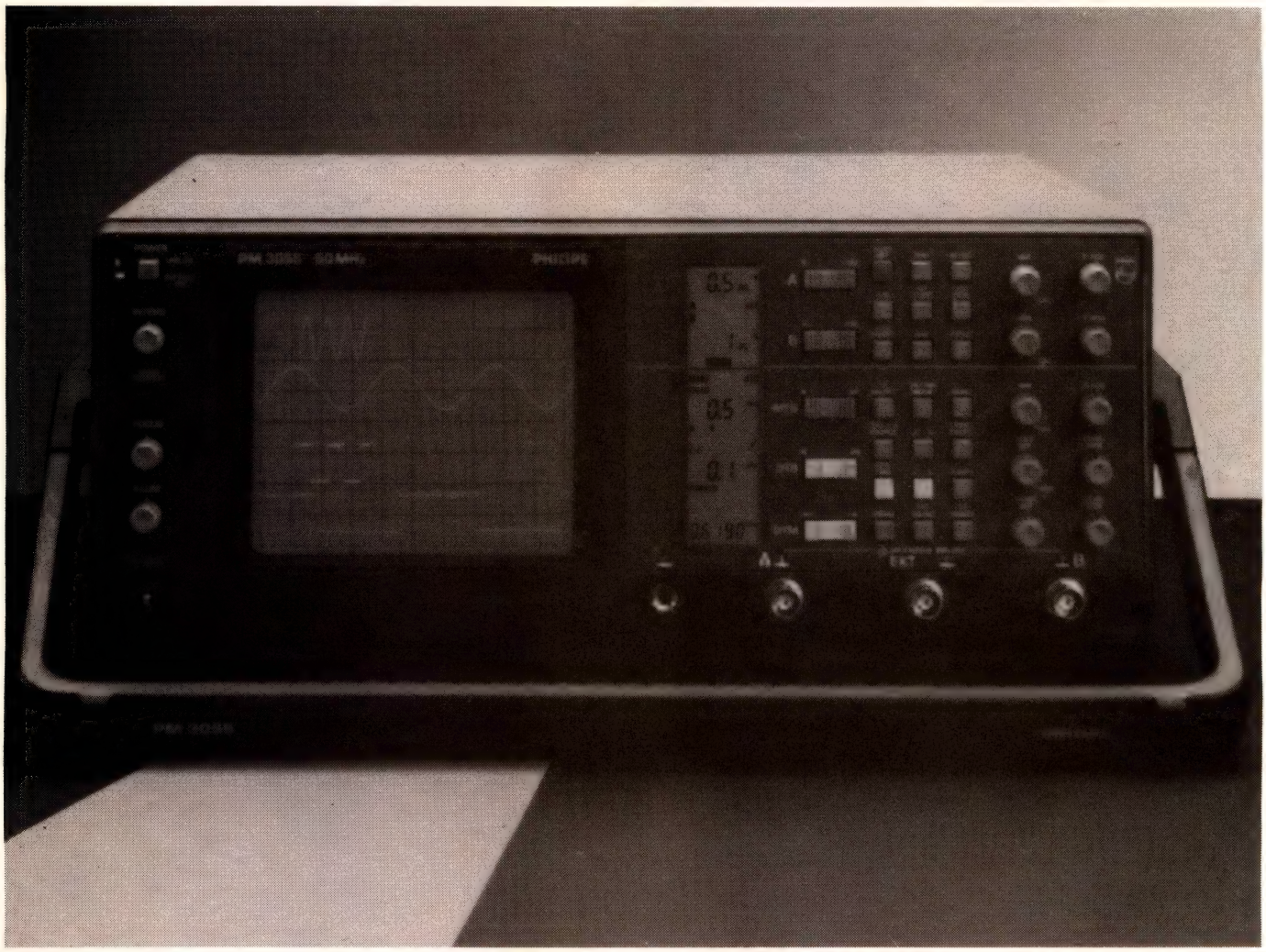


Here's a prize every reader will want!

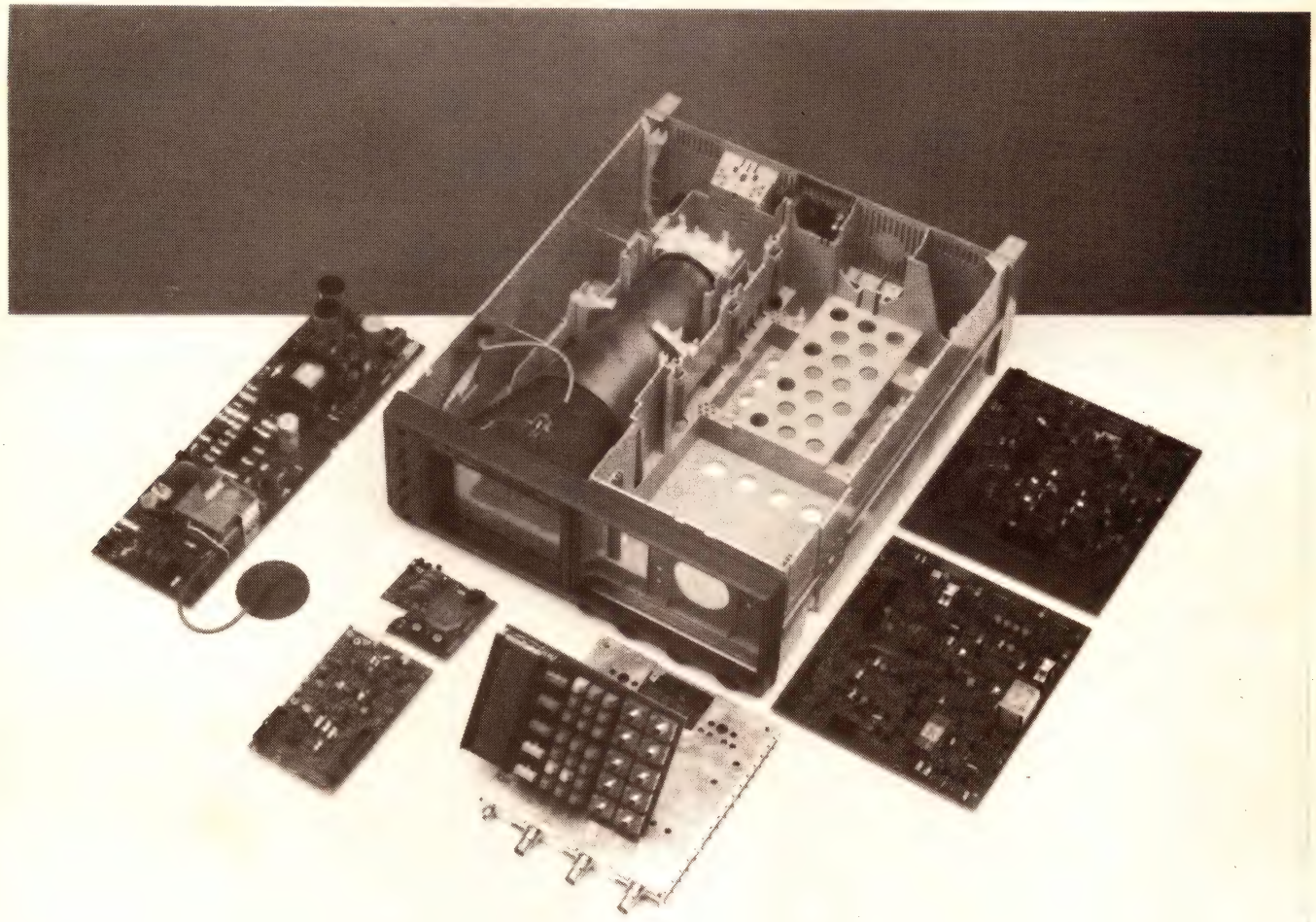
Win this Philips microprocessor-controlled CRO, model PM3055 – it started life as a 50 MHz CRO, but now features a bandwidth of 60 MHz! PLUS – it comes with two x10 100 MHz bandwidth probes!

Here is a fantastic opportunity to own one of the most sophisticated dual-trace CROs available in its class. Engineer or enthusiast – this is a truly great instrument that will give satisfaction for many years. We thought the PM3055 was such a great instrument after we'd reviewed it last year, we got one for use here at the magazine!

You might remember we gave away a PM3055 as a prize in our 1st Birthday Contest series in 1986! Missed your chance then? Well, have another go!

The PM3055 does away with the conventional rotary switches used on most CROs to select ranges and functions. Instead, selection is by up/down rocker controls and multi-function "softkeys", greatly reducing the number of front-panel controls required. And you "read" the front panel like a book – left to right, top to bottom. It's a natural! Indication of the ranges selected, and the status of the various controls is made on a large LCD panel next to the CRT.

The microprocessor-controlled "Autoset" function is



This prize is worth around $2700!

a considerable time-saver in a wide range of applications. This automatically optimises settings for trace amplitude, plus timebase speed and triggering, to bring any connected signal in range and provide a usable display without the need to laboriously adjust manual settings.

The 8 x 10 cm CRT features a parallex-free graticule with variable illumination. Vertical sensitivity is adjustable over the range 2 mV – 10 V per division. Timebase speeds range from an impressive 50 ns right down to 0.5 seconds. The PM8936/09 10:1 probe set is supplied with this superb instrument. Input sensitivity of the probes is selected automatically and shown on the LCD display when they are plugged in. And the probes feature a bandwidth of 100 MHz!

The injection moulded chassis makes this CRO a very sturdy instrument, and service and repair is greatly facilitated by the modular component assemblies.

CONTESTS CLOSE 31 OCT. 1988

Prize kindly donated by Philips Scientific & Industrial, PO Box 119, North Ryde 2113 NSW.

1) Prior to the 1930s, cathode ray tubes contained a small proportion of a rare gas. Which gas?

. . . . . .

2) Philips Scientific & Industrial recently moved, what was their *old* address?

. . . . . .

3) When using the Philips PM3055 oscilloscope, hitting the 'Autoset' button will optimise the setting for trace amplitude, timebase speed and triggering. What colour is this magic button?

. . . . . .

In 25 words, or less – why do want this prize?

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

Big brother, or little brother, may be watching you!

Jamye Harrison

The Philips organisation recently released a video observation system and over the last two months AEM had the pleasure of reviewing the product.

I MUST CONFESS I have not had a lot of experience with video security systems in the past, so looking at the Philips Observation System was a totally new experience for me, and I guess that would also apply to many readers, too. However, upon unwrapping the equipment, what did present itself it was a clearly set out, easy to set-up and simple to use security or observation system; and those attributes are not usually immediately apparent with many products.

A description

So what's in the box? The complete system comes in a surprisingly small box containing a 12-inch monochrome (B&W) video monitor, video camera, special mounting bracket, three wall plugs, three screws, 10 metres of coaxial cable, and two RCA connectors for usE on an additional length of coaxial cable if you need it. This is the 'basic' system.

You can add up to three extra cameras and a number of slave monitors, as well as attach a video cassette recorder.

The 12" monitor is surprisingly light and compact. It is your standard buff/grey/beige electronics equipment colour. Down on the bottom right hand corner of the front face of the monitor are seven pushbuttons. One of these controls the power on and off for the whole system, including the camera, another selects play-back from an external VCR, while the other five switches allow you to select either manual or automatic cycling of the four possible cameras connected to the system. If more than one camera is in use the system can automatically cycle the display at an adjustable rate to cover a wide range of areas.

Alternatively, you can leave the display showing the view from, say, camera 1 and only occasionally *manually* switch to the view from cameras 2, 3 or 4.

On the rear of the monitor are the four connectors for the security cameras, a potentiometer to adjust the rate of cycling the different cameras in the 'automatic mode', separate RCA connectors for external input and output of both the video and audio signals (useful for connecting a VCR), a switch to select either VHF Channel 3 or 4 on the video output, a 12 Vdc output and the traditional vertical hold adjustment.

The cycling rate between cameras in the automatic mode may be adjusted to display the output of each camera for just four seconds or up to sixty seconds.

Setting up

Setting the system up is simplicity itself. As long as you feel confident about wielding a drill and operating a screwdriver you will have no problems.

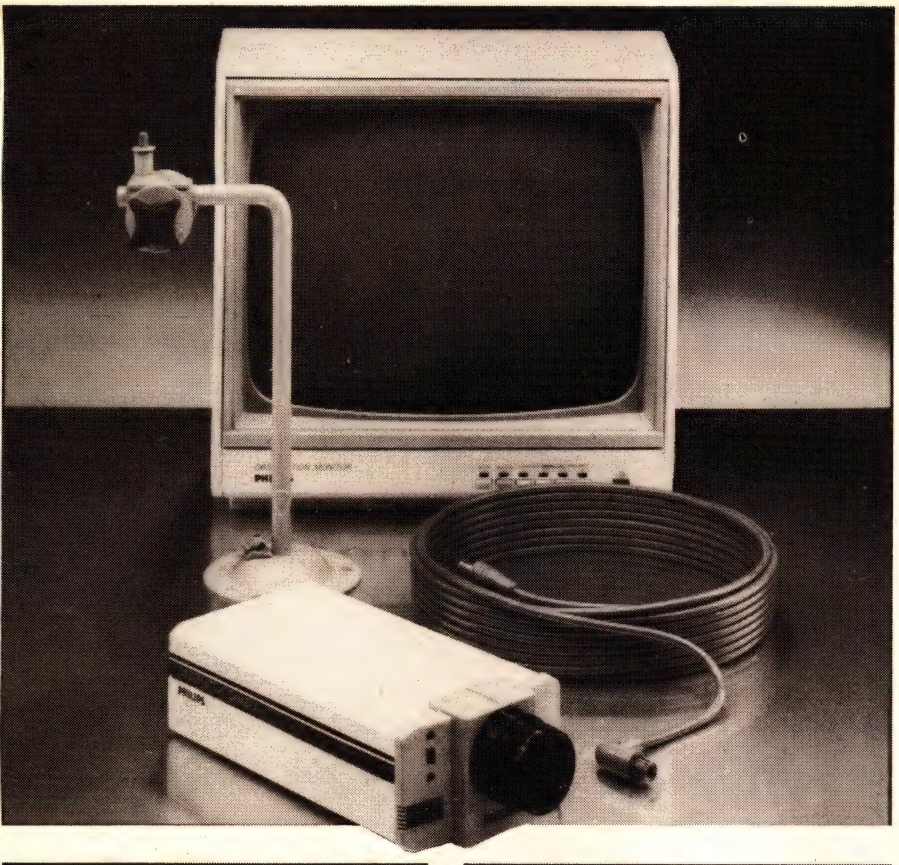
We mounted the camera on a rendered brick wall in our entrance stairwell. This

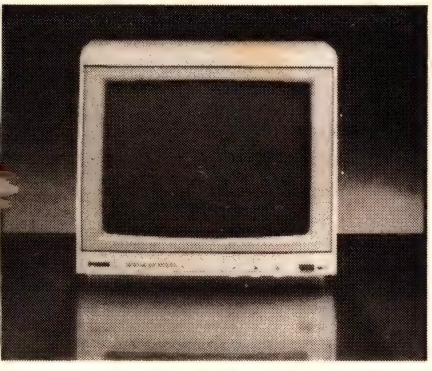
SYSTEM TECHNICAL DETAILS

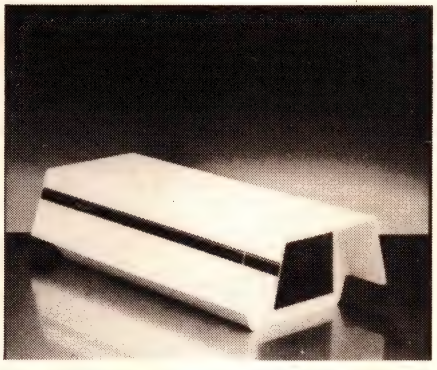
CAMERA	
Pick-up tube	2/3" Vidicon (20PE14 or equivalent
Scanning system	CCIR 625 lines, interlaced
VHF output signal	VHF-1 channels 3 or 4, switchable by an external switch
Illumination range	approx. 3 lux - 30,000 lux (controlled automatically by electronics)
Lens mount	C-mount
Image format	11 mm Ø
Lens	16 mm f1.6, focusing range 1 m to
Field of view	38°
Filter thread	M35.5 x 0.5 mm (camera supplied without filter)
Tripod mount	1/4" (Whitworth) thread
Connection socket and cable	75 ohm coaxial, Euro type
Input voltage	12 V DC (from system monitor via 75 ohm coax.)
Stand-by voltage	4 V DC (from system monitor via 75 ohm coax.)
Power consumption	2.4 watt (200 mA)
Power consumption, 'stand-by'	0.4 watt (100 mA)
Audio	Built-in electret microphone
Ambient temperature	–20 ... +45°C (operating) –25 ... +70°C (storage)
Humidity	Tropicalized 20-95% RH (operating); 99% RH (storage)
Dimensions	228 x 114 x 64 mm (incl. lens)
Weight	Approx. 650 g

SYSTEM MONITOR	
Transmission system B/W	CCIR fixed channel (Ch 3 or 4) for each input
Picture tube	90°, 12"/31 cm, Quickstart
Automatic functions	Line synchronization, black level stabilization, beam current limiter, AGC, stabilized power supply with short-circuit protection for camera
Semi-automatic function	Frame synchronization (vertical hold
Camera selection	Direct access to 4 cameras or sequential automatic mode with adjustable delay time
Maximum ambient temperature	45°C
Mains voltage and frequency	220 V (± 10%, 50 Hz (UK: 240 V)
External supply voltage	12 V DC
Power consumption AC, max.	31 W (including cameras)
Power consumption DC, max.	12 W (including cameras)
Max. camera cable length	More than 100 m, depending mainly on DC resistance of coaxial cable
Camera supply input	75 ohm coax., 4 x PL socket
Sound output	0.7 watt music power
Loudspeaker	3" diameter
Controls	On/off/volume, brightness, contrast, vertical hold, time constant for sequential automatic camera switching (variable from 4 to 60 s)
External connections	Audio/video input and output; RCA cinch sockets for VCR
VCR adapted	Yes, incl. VCR playback switch
Weight	6.5 kg
Dimensions (W x H x D)	34.5 x 30.2 x 30.0 cm

SLAVE MONITOR	
Picture tube	
Type	12" high-resolution picture tube with anti-reflection screen
Deflection	90°
Monitor Input Signals	
1. Cinch plug (video)	Composite video signal with negative synchronization (1 V ± 0.5 Vpp); impedance 75 ohm
2. Cinch plug (audio)	Audio signal (100 mV - 2 Veff.); impedance 10 kohm
Video bandwidth	> 5 MHz
Line frequency	15625 Hz ± 600 Hz
Raster frequency	50/60 Hz
Sound output	0.3 W - 5% distortion
Mains voltage	220 V AC/± 10% (or 240 V AC/± 10% for UK)
Power consumption	30 W
Dimensions (W x D x H)	305 x 303 x 280 mm
Weight	6 kg







At top is shown the basic system; camera, camera mount, 12" monitor and 10 m of coaxial cable. At lower left is shown a slave monitor and right, the weather-proof cover for protecting the camera outdoors.

posed only one problem which I will discuss later.

After determining where to place the camera we attacked the wall with a drill, boring three holes in the wall corresponding to the triangular arrangement of the holes in the mounting bracket. Then we attached the camera to the mounting bracket, as it was easier to attach it while it wasn't up high, out of reach. Following this we hammered the three wall plugs *supplied* into the holes and attached the mounting bracket to the wall with the three matching screws, also supplied. (As you have probably guessed by now, everything except the tools is *supplied*). The camera mount has a very flexible arrangement for adjusting the camera angle, set with a simple hand control knob (visible in the picture here).

The length of coax we then plugged into the rear of the camera and clamped along the required length of cornice until it reach our first floor landing. From this point it was a simple matter of running the cable under the edge of the carpet, around to where we wanted the monitor. We then plugged the other end of the cable into the rear of the monitor. The camera obtains its power (12 Vdc) from the monitor, via the coax, so just plugging it in supplies its power.

It is worth noting at this point that the length of cable supplied, 10 m, is quite enough for most applications, although if we had needed to we could have used the two extra RCA connectors supplied and run a length of coax up to 100 m long; which I am sure is more than enough for most people's needs.

The final stage of the setting up is the most difficult. On the rear of the monitor is mounted a power cord which needs to be plugged into a power point and the monitor turned on. Voila! An operating video observation system. It took half an hour to decide where to put and about the same time to install!

The documentation supplied with the system is simple, straightforward and clearly set out. Like other Philips products we've reviewed or used, Philips do well with their documentation.

In operation

So, what's to comment about the operation of a black and white security system? Not Much?

On the contrary, the Philips system has a lot going for it, apart from its simple setting up procedure. The camera has automatic aperture control, adjusting itself to different light levels from 3 to 30 000 lux. This feature is useful when the camera is mounted where the light level is governed by the time of day (such as our stairwell). The camera will compensate as the light level changes, giving you a clear, crisp picture in most light conditions.

However, you are cautioned against placing the system where it would 'see' very high light levels or get direct sunlight as this damages the ⅔" vidicon tube after a period of time. In the position we mounted the camera reviewed, it looks directly along a short hallway to the outside entrance door, which is largely glass. This door faces west and there are times in the late afternoon when the Sun shines directly through. Some repositioning was necessary. A little research will save you facing the same problem.

To give you some idea how bright 3 lux is, the light level in a 'normal-sized' room with a 40 W reading lamp turned on might be 10 lux. Thus the light level in say, a very dim hallway, is roughly three to five lux. Most domestic video cameras will successfully film in light levels of only about 7-10 lux (albeit, you get a "muddy" picture).

Another desirable feature of the system, which we have not seen in similar systems, is the camera's in-built condensor microphone, which provides for very sensitive audio monitoring of the goings-on in the vicinity of the camera.

Our offices are located above a real estate agent, and when we have the camera system switched on we're able to hear normal conversations being held in any of the rooms below us, 8-10 metres from the camera! Not bad.

Applications

The Philips Observation System lends itself to a host of applications, mundane or unique. As it retails for $1135 including. tax, it is a small investment whether considered for domestic use, in a business or perhaps an education establishment such

• to page 60. ▷

Using the 555 and its dual, the 556

Part 2

Roger Harrison

The best way to learn most practical things is by doing. Now you can try out a few circuits, get to know the "tricks" of using the 555 and maybe make a few practical projects at the same time.

IT IS VERY EASY indeed to "lash-up" 555 circuits on a piece of perforated phenolic construction board ("perf-board") or one of those "prototype breadboards". So, for those readers unfamiliar with the practise of lash-ups, our first circuit this month is something *guaranteed* to work, unless you do something fundamentally wrong, shown in both circuit form and in "mechanical schematic" form. Build this and you'll be able to move on to the circuits following with the confidence that you'll be able to get them going. For those already experienced at lashups — read on, we've plenty to occupy you here!

Morse practice oscillator

A quick scan of the circuit in Figure 6 here, and then back to Figure 4 (Part 1) will show you this is just a practical application of the 555 as an oscillator. Here, a speaker is added to provide audible output and the Morse key turns the oscillator on and off by switching the timing resistor-capacitor circuit to the power supply. The value you choose for C1 will set the pitch of the oscillator. A value of 100n (0.1μ) will give a pitch very close to 500 Hz, or 82n will put it close to 600 Hz.

You can work this out using the equation given in Part 1.

$f = 1.44/(R1 + 2R2)C1$

As R1 and R2 are both 10 kΩ

$f = 1.44/(30\,000 \times 100 \times 10^{-9})$

$f = 1.44 \times 10^3/3$

Thus, $f = 1440/3$, which is 480 Hz!

An ordinary "greencap" or other metallised polyester capacitor is ideal for C1. You may use any sort of low impedance loudspeaker. It doesn't have to have an 8 Ω voice coil, a 4 Ω or 16 Ω type will do equally well. Likewise, size doesn't matter either. In fact, the larger diameter speakers you'll find more sensitive, with louder results!

Increasing the value of R3 will reduce the loudness of the sound from the speaker, reducing it will increase the output. Don't drop the value below about 15 Ohms, though. The circuit may be powered from a power supply or a battery — 4.5, 6 or 9 volts. If you use a power supply, ensure the voltage does not go above about 15 volts. At higher voltages, increase the value of R3; 56 or 100 Ω will do. If you use a plugpack dc supply, you may need to connect a 470-1000 μF electrolytic capacitor across the supply inputs to eliminate hum.

A simple timer

Now we're ready to tackle a few simple timers. Often, you'll need to drive a relay, but there's a trick to it, to protect the 555 from the inductive "kick-back" of the relay coil when the current is turned off. Figure 7 shows how to drive a relay from the 555's output. Firstly, diode D2 absorbs the relay's turn-off kick-back voltage, which will be negative-going. Secondly, diode D1 counteracts the small residual voltage that appears at pin 3 of

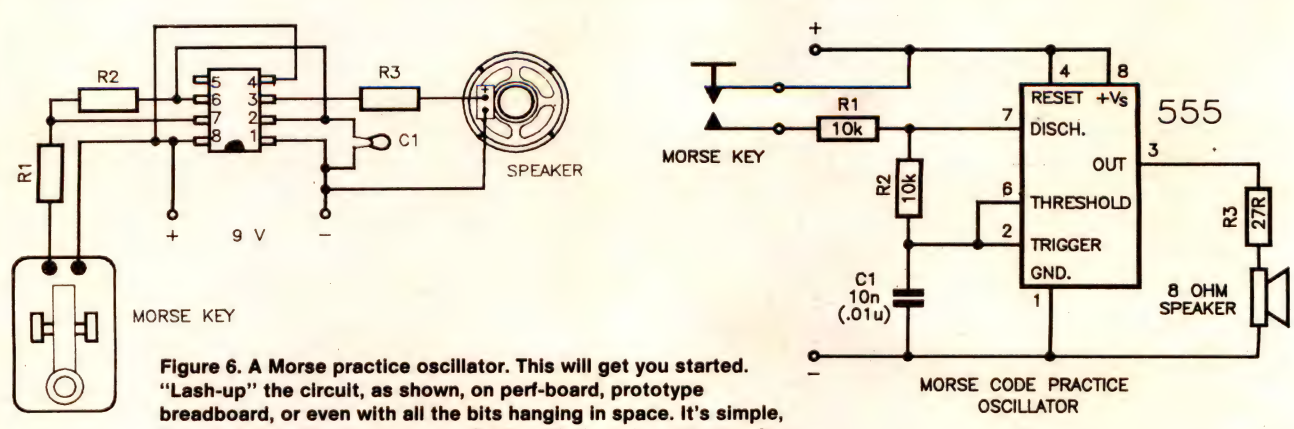


Figure 6. A Morse practice oscillator. This will get you started. "Lash-up" the circuit, as shown, on perf-board, prototype breadboard, or even with all the bits hanging in space. It's simple, it works every time, and you can fiddle with the values to see what effect they have.

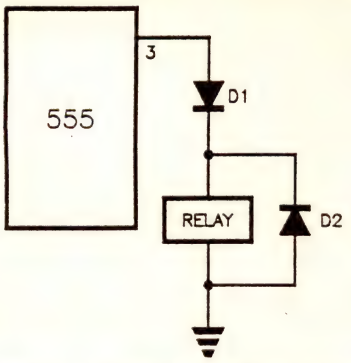


Figure 7. How to drive a relay from the 555's output. D1 counteracts the 555's 'off' voltage while D2 absorbs the relay turn-off kick-back voltage.

the 555 when it's 'off' or 'low'. Now you know why the output waveforms in Figures 2 and 4 showed the output voltage not quite reaching zero volts.

Any suitable silicon diode with a forward current rating of 50-100 mA or more will suffice; 1N914s, 1N4148s, 1N4002s etc are all common and ideal for the job. As for the relay itself, it's advisable to use small, sensitive relays with a 250-400 Ω coil that don't require too high a pull-in current. Fortunately, many suitable relays are widely available.

Figure 8 gives the circuit of a simple variable timer. The 1M potentiometer sets the required period. Maximum period is close to 15 seconds. The 47k resistor sets the minimum period to about half a second. The 'reset' and 'start' buttons are momentary-action pushbuttons.

Pushing the 'start' button will trigger the 555, turning the relay on. It will turn off some time later depending on the setting of the potentiometer. At any time while the relay is operated, you may reset the 555 by momentarily pushing the 'reset' button, cutting short the timing period. Note that the 'reset' pin (4) is held at a positive potential by the 10k resistor to the supply rail. When the reset button is pressed, pin 4 is pulled to zero volts, resetting the internal flip-flop.

The maximum period may be extended to beyond 150 seconds by increasing the 10µ timing capacitor to 100 µF. Exactly what it will be depends on the tolerance of this capacitor. Electrolytic tolerances are pretty broad. You can calibrate the 1M potentiometer with a stop watch.

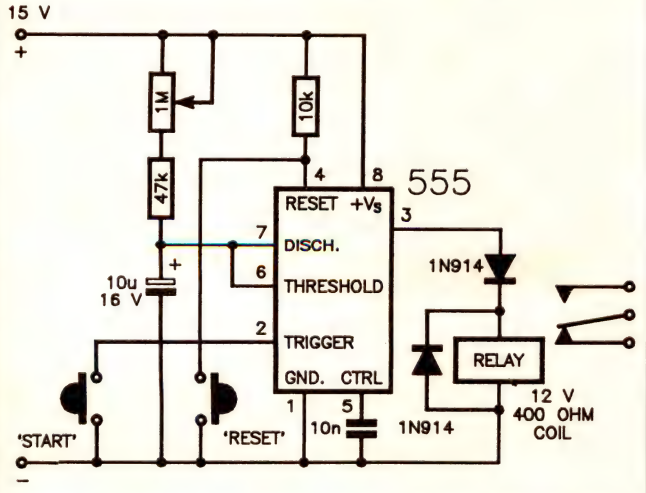


Figure 8. A simple timer. You can use the relay to switch another circuit, on or off as required.

For an interesting little experiment, you can see how the 555 operates and verify the graph in Figure 2 of Part 1 showing the charging of C1 in relation to the output timing period. For this, you need a high input impedance multimeter — it should have a 2M input impedance or greater. An analogue meter is best, say a FET-input type, or a digital multimeter.

Set the 1M potentiometer to get a timing period of two seconds or so. Connect the multimeter across the timing capacitor and then press the 'start' button. The relay will operate and the meter reading will quickly rise. As it rises further, its rate of rise noticeably slows down. If you're using a 15 V rail, as shown in Figure 8, it slows down as it approaches within a few volts of 10 V. When it reaches the vicinity of 10 V, the relay will drop out and the meter will quickly fall to zero.

General purpose timer

A drawback with the simple timer, as mentioned, is the uncertainty of the maximum timing period as it's dependent on the tolerance of the timing capacitor. You can over come this drawback by means of a very simple, and rather elegant, little trick making use of one of the control pin of the 555. Figure 9 shows it.

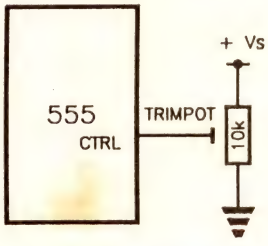


Figure 9. How to set the maximum timing period using the control terminal, pin 5. It's cunning, because the trimpot set the upper threshold point.

The trimpot wiper applies a potential to the control pin (5) of the 555. This fixes the upper threshold voltage of the internal voltage divider and thus the trip voltage of Op-Amp 1 (see Figure 1, Part 1). Thus, the 555 turns off exactly where you want it to, despite the fact that wide tolerance electrolytic capacitors are used.

Applying what we've learned here, you can make a general purpose timer with a presettable maximum period. Figure 10 is a practical general purpose timer with two decade ranges selectable by SW1. The shorter period covers from under a second to 10 seconds, the longer period covers from under 10 seconds to 100 seconds. Trimpot RV2 sets the maximum time of the shorter period, RV3 sets it for the longer period. Thus you can use the same calibration of RV1 for both ranges.

Adjusting the timer is a little tedious, but patience helps. With power on, use your multimeter to set the voltage on the wipers of RV2 and RV3 to about 10 volts. Set SW1 for the longer period and RV1 back a little from maximum. Now, press the start button and, with a stop watch, time the period until the relay drops out. If it's more than 100 seconds, adjust RV3 so as to *decrease* the voltage applied to pin 5 of the 555. If it's less than 100 seconds, go the other way. Once you've got that right, *do not touch RV1.* Switch SW1 to the shorter period, start the timer again and time the period. Adjust RV2 as you did RV3.

So what do you use a timer like this for? Any sort of process timing; e.g: printed circuit resist exposure timing.

Headlight delay timer

You've no doubt had many occasions when, having parked and locked your car somewhere at night, maybe even in your own driveway, you'd liked to have *seen* where you're going, there ▷

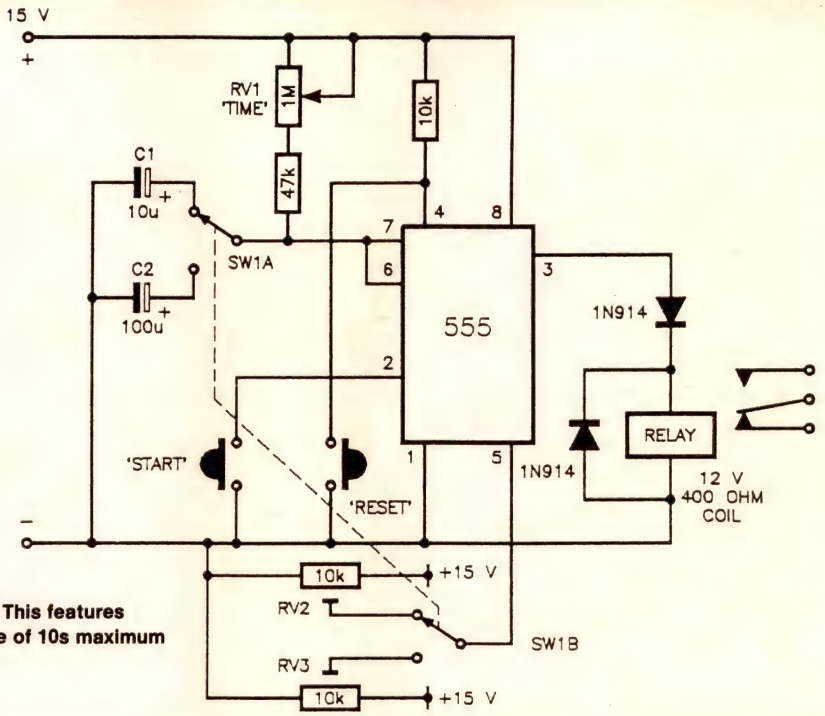


Figure 10. A general purpose timer. This features two overlapping decade ranges, one of 10s maximum period, the other of 100s.

being no natural or other illumination. That's what a headlight delay timer is for. It will keep your headlights on for 30 seconds or a minute after you turn off the ignition.

The circuit shown here in Figure 11 is just the thing for the job. Comparing it with Figures 8 and 10 you'll see some similarities. The 470k resistor and 100µ capacitor give a period of about 50 seconds.

When you turn on the ignition, the relay's coil receives current via the upper diode. This closes the relay contacts which then applies power to the 555. The 10n capacitor is held discharged via the 22k resistor.

Now, when you have your headlights switched on, the moment you turn off the ignition the current to RLA1 is turned off, but it will take some milliseconds before the coil's field collapses and so the relay contacts remain closed momentarily. At the same time, the 10n capacitor on pin 2 charges via the 22k resistor from 12 V and the 1k resistor to chassis. This applies a negative-going pulse to pin 2, triggering the 555. Pin 5 then supplies current to the relay coil which maintains the contacts closed and the second set of relay contacts maintains the current to the headlights. After 50 seconds, the 555 turns off, turning off the relay and thus the headlights.

More to come

That should get you a little experience with the 555, particularly as a timer. In Part 3 we'll have a look at some simple oscillator applications (we've already shown you the simplest one here!). Meanwhile, warm up the soldering iron, take out the "junk" box and tackle a few timers.

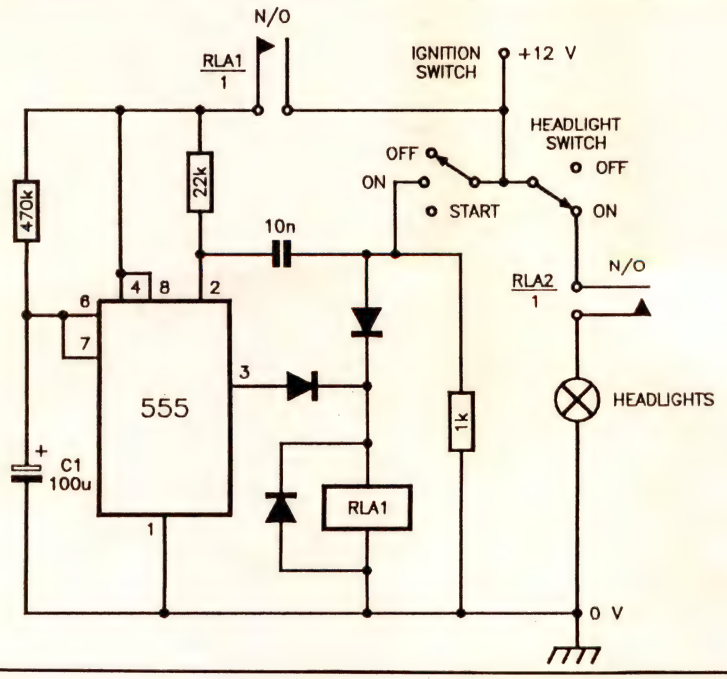


Figure 11. A headlight delay timer.

AUSTRALIA TELESCOPE, from page 15.

as transferred to the Intergraph system which then generated number of views of the structure to find the one which was ost useful for all the final drawings.

The most powerful processing system of its kind, designed d built wholly in Australia, CSIRO's Intergraph system was ed for almost a year to design the correlator circuit boards.

mming up

ere's little doubt that this project, built at the comparatively v cost of $50 million, puts Australian radio astronomy once ain at the forefront of the science and places us in a unique sition in the worldwide scientific community.

Radio Astronomy pioneer, Dr Grote Reber, was invited to the ening ceremony at Culgoora. His comment: "... elegant", ich would seem to sum it up in a word.

cal suppliers

llowing is a list of major Australian suppliers to the Australia lescope project:

Andrew Antennas, NSW.
axial cable and dish, valued at $70 000.

Austek Microsystems, SA.
SI chips costing $400 000.

Barclay Brothers, NSW.
vil engineering work, $3.5 million.

W. Chandler, NSW.
ctrical fitting, $150 000.

Convex Australia, NSW.
percomputer, $1 Million.

Evans Deakin Industries, Qld.
tenna construction, $15 Million.

Electronic Development Sales, NSW.
F amplifiers (imported), $260 000.

Hawker de Havilland, SA.
PIN diode switches (imported), $220 000.

- Huber & Suhner (Aust.), NSW.
SNA contractors., $30 000.
- Hewlett Packard, NSW.
Test equipment, $200 000.
- Intergraph Corporation, NSW.
Computer aided design facilities, $300 000.
- Macdonald Wagner, NSW.
Consulting engineers, $2 Million.
- MAA Pty. Ltd, NSW.
PIN diode switches (imported), $70 000.
- MIL-COM Associates Inc., Vic.
RF amplifiers (imported), 50 000.
- Mitec Ltd., Qld.
Microwave components, $60 000.
- Nu-Tech Circuits Pty Ltd, NSW.
Printed circuit board assembly, $40 000.
- Precision Graphics Pty Ltd, NSW.
Printed circuit boards, $20 000.
- Printronics Pty Ltd, NSW.
Printed circuit boards, $20 000.
- Pirelli Cables, NSW.
Fibre optic cables, $200 000.
- Quality Tool & Die, NSW.
Miscellaneous hardware, $150 000.
- Sydney Engineering Service, NSW.
Subreflectors, $100 000.
- Thytec Electronics Pty Ltd, Vic.
Uninterruptable power, $150 000.
- WAMAC Tool and Manufacturing, NSW.
Miscellaneous hardware, $40 000.

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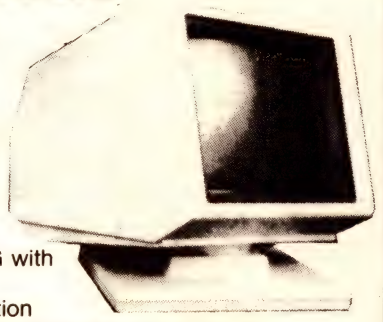

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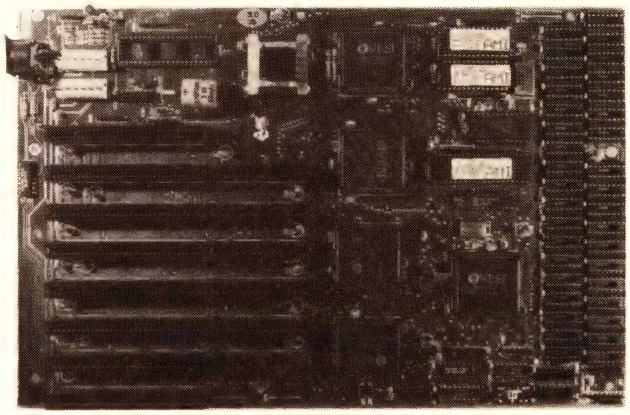

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Seven fundamental electronic facts

Part 3 — Capacity and induction

Bryan Maher

In this third of a four-part series the author asks about the theories formulated to explain capacitive and inductive effects. "On what basis do we trust such theories?" he asks. "We have even grown used to referring to them as 'laws'."

AWAY BACK in the mid-1700s the capacitor was used to store electricity as electric charges (negative electrons and positive ions). It was then called a "condenser" or a "Leyden Jar" after the university of Leyden.

Experiments show that for any two separated conductors a current i flows proportional to the rate of change of voltage between the two conductors. The constant of proportionality we call C, the "capacitance" formed between these two conductors.

Though we often deliberately make up a component consisting of two conductors separated by a space or solid insulator, the effect occurs between any two conductors separated by insulating material, whether we want the effect or not!

The word "dielectric" is often used for "insulating material" in this context. In equation form, the current i is equal to:

$$i = C\,\delta V/\delta t$$

where i = the "capacitive effect current" in amperes.
V = the voltage between the conductors.
C = the constant, the "capacitance", measured in Farads (after Michael Faraday, England, 1791-1867).
$\delta V/\delta t$ = the rate of change of voltage in volts per second as in Figure 1.

We emphasise that this law is true in all situations, wanted or unwanted.

In electronics we often want the effect and deliberately form a component called a "capacitor" from metal plates, tubes or sheets, held apart in some manner.

In power and telephone line work we wish this capacitance effect between line conductors did not exist as it causes unwanted currents, but we cannot stop it.

The capacitance effect current is associated with the changing electric field existing between the conductors when a changing voltage is between them. In all ac systems, including those at power line frequency, i.e: 50 Hz, all the way up to RF, VHF, and UHF, experiment shows this law to be true.

Of course, at low frequencies and low voltages the rate-of-change is not so great, so correspondingly the capacitive current is not so high unless the capacitance value is very large.

At any one (sine wave) frequency the highest value of the rate-of-change is proportional to the product of the peak value of voltage multiplied by the frequency.

Direct current (dc) systems. From the equation we see that if V is constant then there is no capacitive current, except at switch-on and switch-off, because a constant quantity has no rate-of-change, no derivative (that's the mathematical *derivative).* Hence no capacitive effect occurs at dc.

This is the impetus for building very high voltage dc power lines over long distances in some countries. An example is the dc high voltage interconnector power line between Benmore in the South Island of New Zealand, 300 km to Cook Strait and then by submarine cable to the North Island.

As an example, a certain high voltage power line in NSW runs from the Snowy Mountains power stations to Yass in central NSW. The line voltage at the Snowy is 345 000 V RMS, the frequency f is 50 Hz, and although those big conductors are spaced quite a distance apart, because of their great length the capacitance between the conductors amounts to about 1.85 μF.

As well as the usual load current of about 800 A flowing, there is an extra current component, the capacitive current flowing in the line just because of this capacitance effect.

This capacitive current can be found, as follows:

Line voltage = 345 000 V RMS, sine waveform.
Peak line voltage = (345 000)(1.414)
Frequency f = 50 Hz

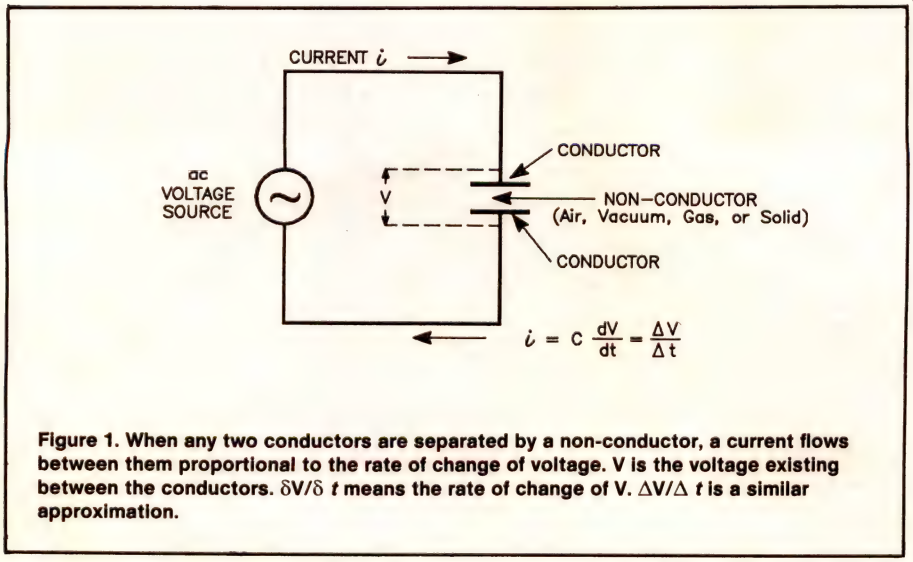

Figure 1. When any two conductors are separated by a non-conductor, a current flows between them proportional to the rate of change of voltage. V is the voltage existing between the conductors. $\delta V/\delta t$ means the rate of change of V. $\Delta V/\Delta t$ is a similar approximation.

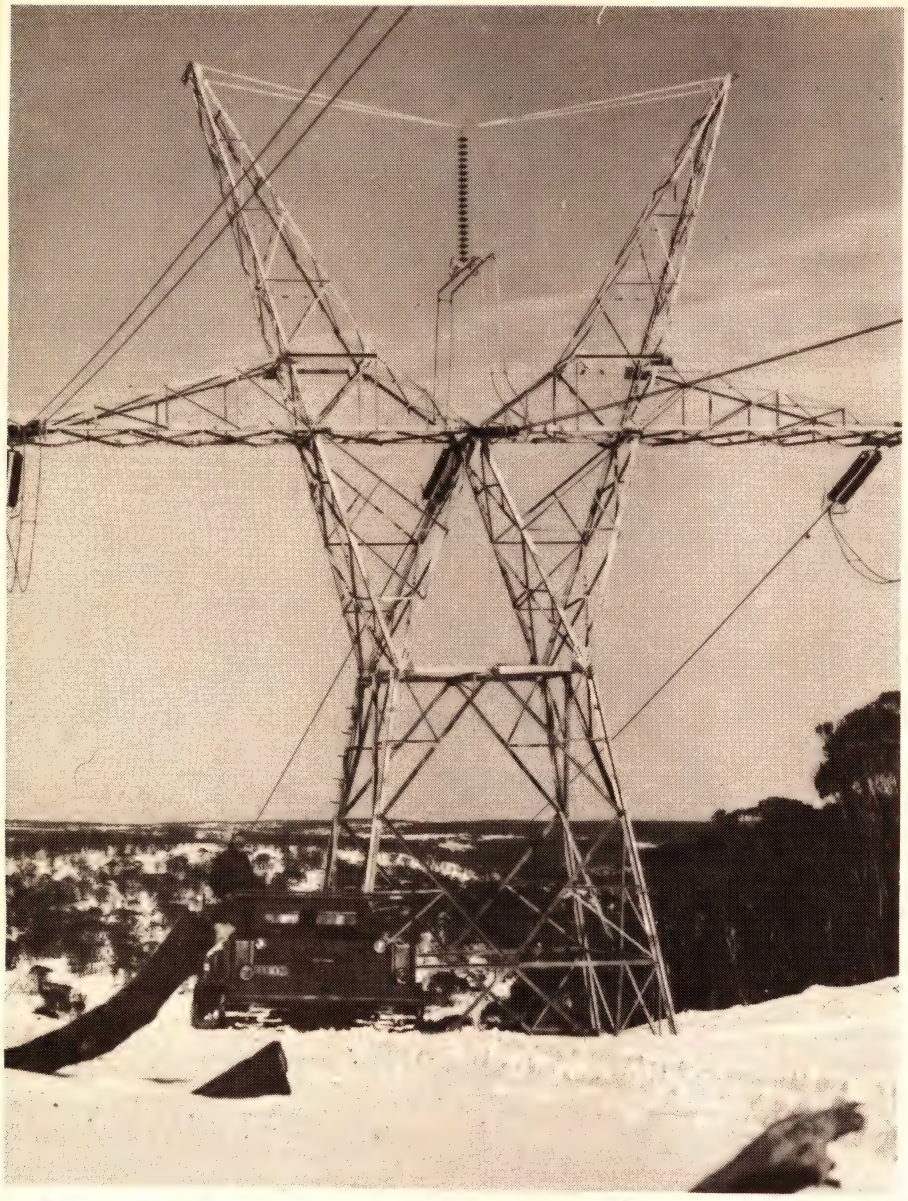

Figure 3. One of the power lines from the Snowy Mountains power station. V = 345 kV RMS leaving the power station; current up to 1000 amps. Capacitive current flowing is 200 amps over the full line length.

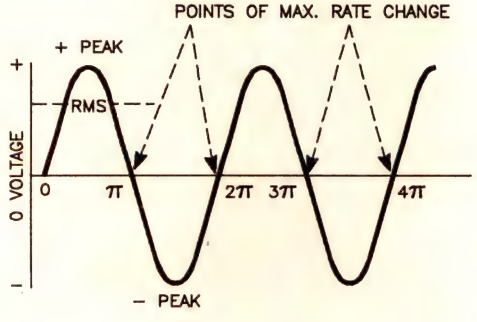

Figure 2. Maximum rate of change of voltage for a sine wave occurs every, 0, π, 2π, 3π etc radians, or each 10 milliseconds for the 50 Hz mains. RMS value of the voltage equals 0.707 × peak voltage.

Voltage at any time t is given by $V(t)$ and is equal to:

$V(t) = (345\ 000)(1.414)\sin(2\pi ft)$

$C = 1.85\ \mu F$

$\pi = 3.14159$ etc.

Capacitive current $i = C\ \delta V/\delta t$

$i = (1.85/10^{-6})(345\ 000)(1.414)(2\pi 50)\cos(2\pi ft)$

$i = (284\ A)\cos(2\pi ft)$

When $(2\pi ft) = (2\pi$ radians), or any multiple thereof, the voltage sine wave is experiencing its greatest rate-of-change as in Figure 2. At these times the cosine function is at its greatest value, given by $\cos(2\pi f) = 1.0$.

Therefore, the capacitive current $i = (284\ A)(1.0)$ must be the peak value, meaning:

$i = [(284\ A)/1.414]$ RMS

Capacitive current $i = 201$ A RMS.

This unwanted capacitive current component adds to the load current, and heats the line conductors more. This reduces line efficiency, especially at times of light load.

Even if the receiving end circuit breaker at Yass were opened, i.e: the line supplying no load, there would still be that 201 A capacitive current flowing from the Snowy Mountains power stations into that line.

Oscilloscope deflection. As a second example, look at an oscilloscope. We usually look upon oscilloscope tubes' deflection plates as easy "loads" for a deflection amplifier to drive. After all, they are nothing but a pair of little plates "separated by a vacuum".

As a load they look at first sight to be just "an open circuit at the ends of two wires".

But not so fast, gentle reader!

Consider the design of a 1.0 GHz CRO as sketched in Figure 4. Oh yes, unbeliever, such oscilloscopes are on the market. Yes, real time: we are not considering sampling oscilloscopes.

If the capacitance between the deflection plates including strays is 10 pF, and the signal at the deflection plates is 20.0 V peak sinewave, then the only load upon the transistor amplifiers will be the capacitive current caused by the capacitance of the deflection plates. This is because there are no resistive loads.

Voltage at plates $V(t) = 20.0\sin(2\pi ft)$

$\delta V/\delta t = (20.0)(2\pi f)\cos(2\pi ft)$

Capacitive current $i = C\ \delta V/\delta t$

$i = (10.0)(10^{-12})(20.0)(2\pi 10^{9})\cos(2\pi ft)$

$i = 1.26$ A peak.

Well, astounded reader, did you ever think that so much signal current would be required from a little amplifier just to drive a pair of CRO deflection plates ? Surprising, isn't it?

Comparing examples. (1) Comparing the two, in the first case the frequency is ▷

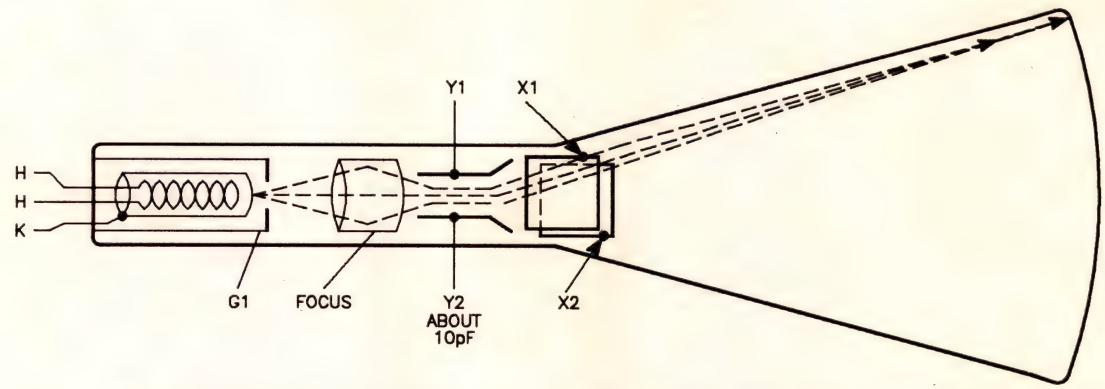

Figure 4. A cathode ray tube (CRT). The Y or vertical deflection plates are the most difficult to drive for very fast vertical deflection rates because of the rate of change of voltage. Even 10 pF capacity at 1 GHz and 20 volts peak requires 1.26 amps drive current!

low at 50 Hz, and the capacitance value is middle-of-the-road at 1.85 μF. But the voltage is very high at 345 000 V RMS, resulting in a large charging current.

(2) In the second example the voltage is low, the capacitance is extremely small. However, because of the extremely high frequency the charging currentis surprisingly high.

But both those examples are from real life!

Bypass capacitors. On the credit side there are many situations in electronics where we certainly do want the capacitive effect. Most ac-to-dc power supplies for your mains powered equipment use large value electrolytic capacitors as in Figure 3-5 for their action in bypassing the ripple current to ground to get rid of it. This leaves only the dc component wanted by your radio and TV.

Here we make good use of the capacitive current equation which passes any changing voltage to ground, but does not pass dc because dc has no rate-of-change.

Electrolytic or solid tantalum capacitors are used in bypassing the mains ripple to ground because these types of capacitors have the very high capacitance value (many hundreds to thousands of μF) needed because the frequency is a low 100 Hz, and the ripple voltage is small.

As an example (4), the capacitive current effect helps us to "capacity-couple" two amplifier stages together where we want to pass the ac signal but block any dc level superimposed upon that signal, as in Figure 6.

The equation $i = C\ \delta V/\delta t$ is saying loud and clear that if the rate-of-change "$\delta V/\delta t$" is small, then the same current, *i*, can result if we sufficiently increase the value of C. For this reason, if we want our little circuit of Figure 6 to couple quite low music frequencies (low value of $\delta V/\delta t$) on to the next stage, we expect to see a high-value coupling capacitor used.

Aside: The right choice of C is also tied up with the value of input resistance of the following stage — but that's another story, maybe for another day.

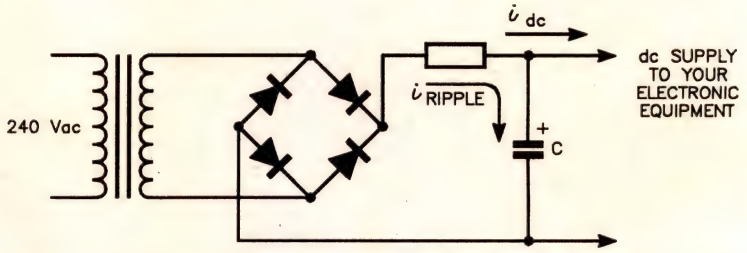

Figure 5. Most ac/dc power supplies use an electrolytic or tantalum capacitor, C, to pass the 100 Hz ripple current to ground (to get rid of it), leaving smooth dc for your electronic equipment. (Well, that's one way of looking at it).

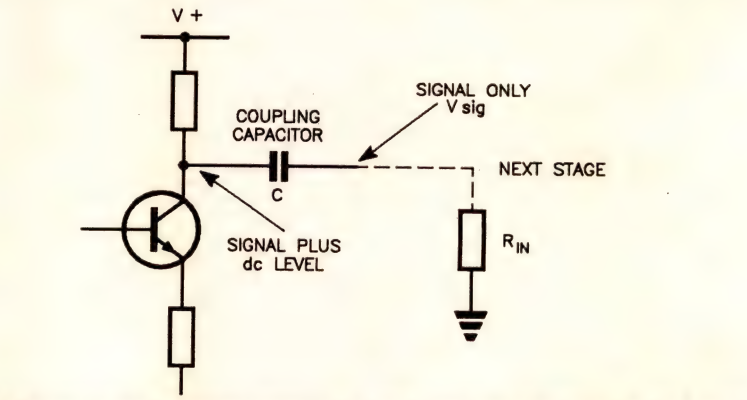

Figure 6. We often use a coupling capacitor to pass signal but block the dc. The coupling capacitor passes the ac signal because $i_{sig} = C\ \delta V_{sig}/\delta t$. The dc level is blocked as its rate of change is zero.

The fifth law: inductance

Quite separate from the voltage drops that are proportional to current and which are caused by components' resistance, in every circuit there is another voltage drop. This is not proportional to current at all but is in fact proportional to the rate of change of current. Experiment confirms that this effect is present in all circuits, whether we want it or not.

While this effect is not related to the resistance of conductors it is related to their physical size and shape. This makes it small for straight conductors.

The effect is larger if the conductor is coiled. It is larger still if a core of iron or cobalt, nickel, or some of their alloys is put inside the coil.

But we emphasise that the effect is inherent in all ac circuits, whether the effect

is wanted or not.

Inductance. The constant of proportionality is called the "inductance" of the circuit or component, denoted by the symbol L.

Thus, in equation form:

$$V = L\,\delta i/\delta t$$

where

V = the "inductive voltage drop"

L = the inductance in Henries (after Joseph Henry, USA, 1797-1878)

i = the current flowing in the circuit

t = time in seconds

$\delta i/\delta t$ = the rate of change of current in amps per second (A/s) as in Figure 7.

The inductive effect is caused by the changing magnetic field associated with the changing current in the circuit.

Lenz's law. The inductive voltage generated by the changing current opposes the direction of change. This is known as Lenz's Law.

Think of it this way: suppose you decide to change the current from one value to another. The inductive action resists the change by generating its own voltage "V" in a direction which tries to keep the current at its original value.

For example, if we decide to decrease the current, the downward rate-of-change of current will generate an inductive voltage, V, in a direction which tries to raise the current back to its original value.

Constant current. From the equation we see that a constant current, no matter how large, produces no inductive effect at all. This is because a constant current has no rate-of-change $\delta i/\delta t$.

However, switching a large dc current on or off produces very large value of $\delta i/\delta t$ at the moment of switching. So it can produce a *huge* inductive voltage for that very short time of switching, as illustrated in Figure 8.

Sometimes we put the inductive effect to good use (as in a car's ignition coil), and sometimes it is a nuisance (e.g: switching a relay coil), but always it exists.

Transformers and chokes

On the credit side, the inductance of coils is the very essence of how all transformers operate. Without the inductance effect we would not be able to change supply voltages to suit ourselves. This is a practice fundamental to all mains operated electronics nowadays.

Also the ability of inductance to try to keep a current flowing steadily, negating changes in current value, can be put to good use in smoothing rectified dc.

The inductance of coils is also a vital element in operating electric motors, relay coils, electric bells, buzzers, solenoids, and a host of other electrical appliances.

Power lines: on the debit side, there are places where we wish the inductive effect did not exist. One example is the inductance of the straight conductors of our nation's long distance high voltage power lines. "Long" some of them are; for instance, most of Brisbane's electric power comes from the Gladstone power station on three big 275 000 V three-phase lines, each 450 to 500 km long.

The inductive reactance of the conductors is equal to $(2\pi L)\ \Omega$, where L is the inductance, f the frequency (50 Hz), and π is 3.14159. Even though the inductance is reduced somewhat by using two cables in parallel, the inductive reactance of the line still amounts to about 160 Ω. This can cause serious voltage drop as these cables ▷

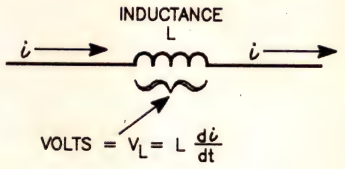

Figure 7. The inductance L may be a component or just the stray inductance of any cable or other electronic part. In every case a voltage v_L is developed proportional to the rate of change of current $\delta\ I/\delta t$.

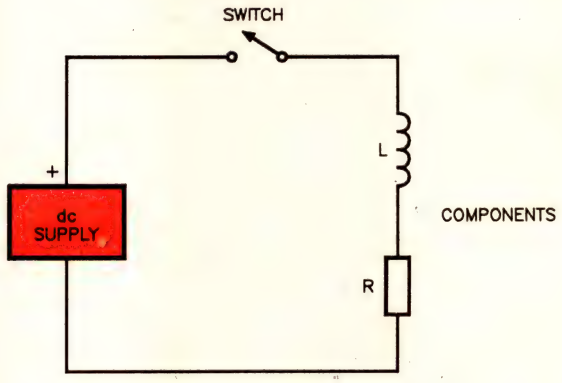

Figure 8. Some components, for example dc field coils on a solenoid or relay, possess considerable inductance plus resistance, shown as L and R (in real life, the two are intermingled). When the dc supply is switched on or off, causing a large rate of change of current, large voltages are developed across the coil.

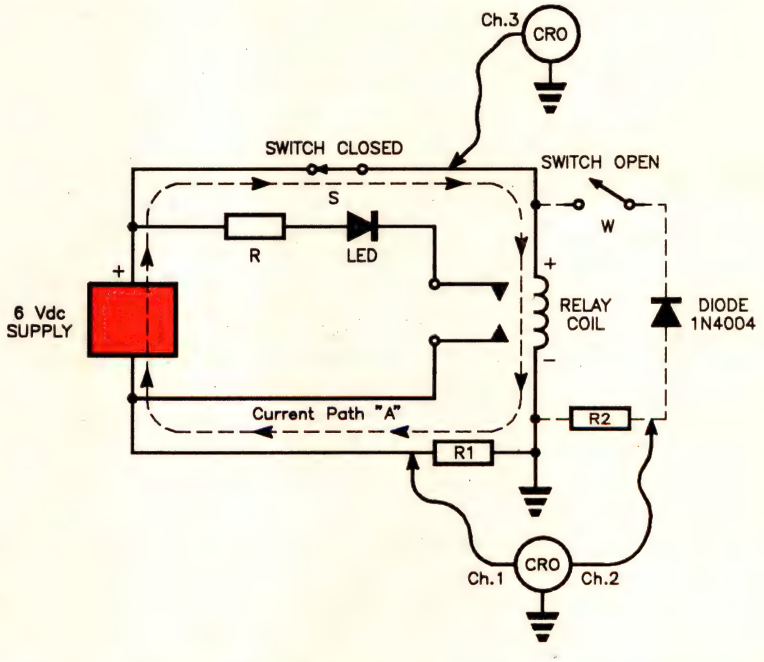

Figure 9(a). Notice the direction of current path "A" and voltage polarity at top and bottom of the coil.

can be carrying 850 A or more of load current.

Meanwhile, back in the world of electronics, inductance's existence is at once an essential blessing and a potential problem: if not properly treated.

An experimental example may help: Figure 9 shows a simple experiment you can do. A dc battery drives a relay coil via a switch S. If switch W is closed, a diode can be switched in parallel with the relay.

The experiment will teach us some of the problems which beset transistors when they are used to switch relays, transformers or similar inductive loads. To demonstrate we use switch S instead of a transistor. Build this little experiment, making sure to get the polarities the right way around, as shown.

The small resistors R1 and R2, together with the oscilloscope (CRO-1) are used to measure the amplitude and direction of the currents flowing. If you have access to two oscilloscopes then CRO-2 is used to measure the voltage at the top of the relay coil.

If you have only one oscilloscope, no problem — just use the one in each circuit position alternately. If your oscilloscope has only one beam, then repeat the experiment three times, moving the probe in turn to the three points. In a dc-coupled instrument, always keep all its inputs switched to dc coupling.

Choose resistors R1 and R2 as small as possible, consistent with a big enough deflection of the oscilloscope beams. If R1 and R2 are chosen as 1.0 Ω each and if the relay is a 6 V/75 Ω type, the relay current of 80 mA will produce 80 mV drop across R1, sufficient to deflect the beam enough.

The experiment works best if your oscilloscope has an adjustable delay-after-trigger facility. This will bring the waveform of interest to the middle of the screen.

(a) Begin with the switch W open (i.e in the "off" position).

(b) Close switch S, (i.e: switch the switch S "on"). Watch the relay contacts close and the LED indicator will light. The oscilloscope CH1 beam will show a step upwards, indicating current flowing in the sensing resistor R1.

(c) After a minute or so open switch S. Watch the relay contacts open and the LED go out immediately.

The oscilloscope beam will drop as the current stops abruptly, but the beam CH3 will show a large high voltage spike caused by the inductive voltage V generated by the relay coil, as the equation predicts.

This is because stopping the current suddenly is a large rate-of-change, i.e: $\delta i/\delta t$ is large.

(d) Now close switch W.

(e) Repeat (b), i.e: close switch S, watch the LED light. Shortly the relay current shown on CH1 settles to its full value. The 1N4004 diode, being reverse-biased, passes no current, as the oscilloscope beam CH2 shows no deflection. The current path B is inactive.

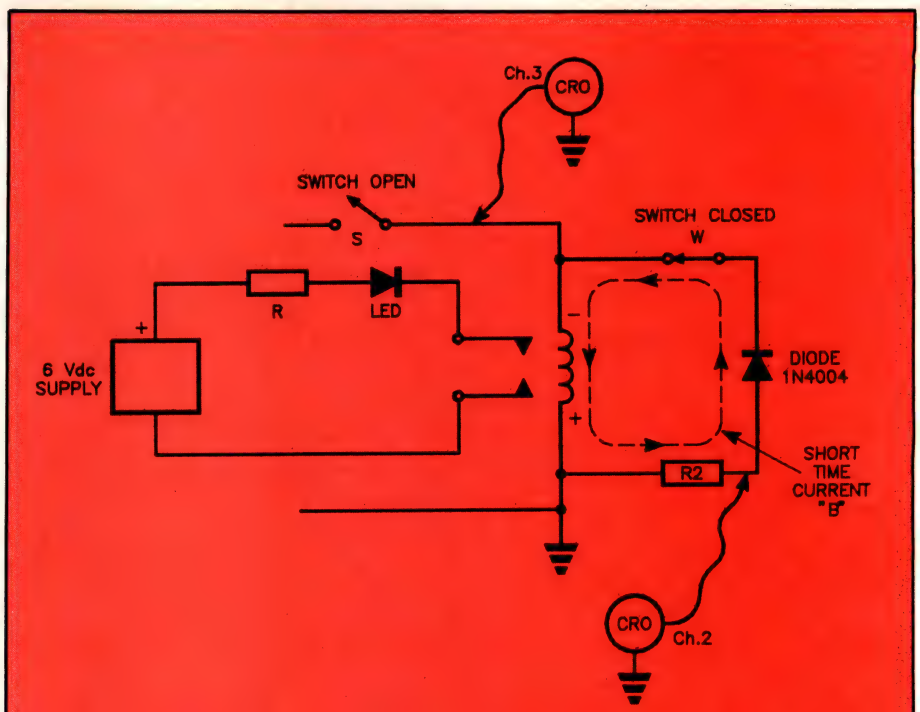

Figure 9(b). Current path "B" is via the 1N4004 diode for a short time after switch S is opened. Notice the current direction is then maintained through the relay coil although, as the coil is a generator, voltage direction across the coil is reversed.

(f) Now watch the LED and all CRO beams as you open switch S. The CH1 beam drops immediately, indicating current path A has stopped.

But notice that the relay contacts hang up in the closed position for a while, causing the LED to continue alight even though switch S is "off".

During this time, keep an eye on CRO beams CH2 and CH3. Observe that: CH2 still shows current flowing in R2.

Note the direction of this current shows that current continues to flow in the relay coil in the same direction even though switch S is open.

Clearly, the battery is not supplying this current.

It is the relay coil itself that is the voltage generator during the short time current continues to flow through R2 and the diode 1N4004.

Observe that only a small voltage is shows on the oscilloscope beam CH3. There is no sign of the dangerous high voltage spike seen earlier, before the 1N4004 was switched into the circuit.

(g) Eventually, the relay contacts open and the lamp goes out.

Result: from this, what have we learned?

In (b), then (c), the relay drops when we switch the current off.

"That's not surprising!" you retort, "What else could it do?"

But now explain (d), (e) and (f). What is now holding the relay contacts closed, keeping the lamp alight? And keeping the current flowing in the relay coil as shown by the CRO beam CH2?

The explanation is that the relay coil has a reasonably high value of inductance L.

With switch W "on", and switch S also "on", the diode is in parallel with the relay coil. But as the diode is reverse-biased no current flows in the diode. Current directions are as shown in Figure 9(a).

But magic things happen when we now switch S to "off", leaving W "on". With switch S "off", the battery can no longer supply current to the coil. Current path (A) is rudely interrupted, producing a downward rate-of-change of current $\delta/\delta t$, i.e: current falling in value, so $\delta i/\delta t$ is a negative quantity.

This "reverse-direction-rate-of-change" of current, $\delta i/\delta t$, brings into action the equation: $V = L\,\delta i/\delta t$.

As the equation says, the inductance (L) of the coil generates a voltage.

It is self-generating because — during this time - $\delta i/\delta t$ is negative. The voltage V generated by the equation above is also negative, i.e: opposite in direction to the voltage which was across the coil before.

But as the relay coil is the generator during this time, the current through it continues in the same direction as before, confirming Lenz's Law. • to page 116.

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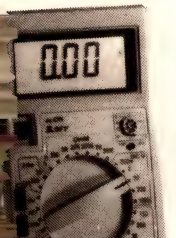

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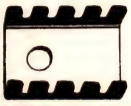

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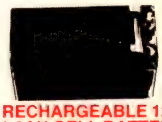

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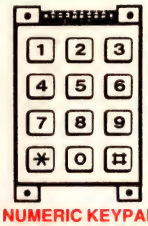

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☞ **AEM PRODUCT REVIEW, from page 49.**

as a school, TAFE or university.

It would seem well-suited as a home security system in a number of situations, in particular, for keeping an eye on the family swimming pool. It would also serve as an ideal 'minder' and shop-lifting deterrent for small businesses such as newsagents, bookshops and clothing stores — especially an electronics retailer! *Merely having a video camera on the premises is deterrent enough for most petty thieves!*

It could also be used to monitor the reception area in a small company where there isn't always someone around to welcome visitors, or perhaps as a front desk monitor during slow times in a motel.

The Philips brochure suggests the system could be used to monitor animals kept in pens or stalls, or to monitor traffic at outdoors events or venues; applications appear only to be limited by your imagination!

As supplied, the system only comes with one camera, although I am assured by Philips that ample stocks of single cameras exist. A wide angle camera lens is also available if the supplied 16 mm/f1.16 lens is not suitable. Standard C-mount lens mounting is used. Another accessory that is available is a weatherproof cover, enabling the camera to be mounted outdoors. This would prove useful when monitoring the front gate to a country property, or perhaps a car park at a sporting or other venue.

Conclusion

At the price, you could hardly go wrong. Video observation systems such as this have proved quite successful over the years. As a security system, they have enjoyed some popularity. However, their value as a deterrent also needs to be considered; it is either very determined, or very *stupid*, felons who will commit their unseemly deeds in the presence of a video camera.

As pointed out, applications are largely limited by your imagination; a video observation system will find application in many areas. And this system reduces the complication — it's simpler to install and set up than a home hi-fi sound system! And in an increasingly high-tech world, simplicity is ever welcome.

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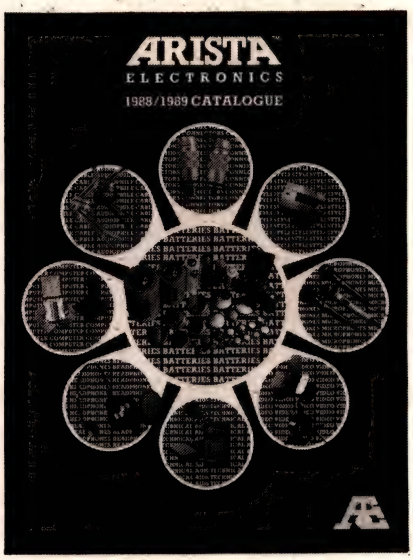

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Power and polish in this German-made PA amp

Roger Harrison

It's rare to see a PA amp of European origin in Australia. There are many home-grown ones, as well as beasts of NZ or US origin. When the opportunity to review this amp was offered we took it up gladly, having been intrigued about the Hertz "Linear 6" series from a press release received earlier this year.

SOMETHING a little out of the ordinary is always intriguing. And this PA amp, the Linear 6.2 from Hertz, is intriguing, not just because of its pedigree but for the design philosophy embodied in the product. If I didn't know better, I'd swear the Hertz designers had read our PA Feature last month on *PA Power Amp Requirements!*

But they couldn't have. It's more likely our correspondent and the Hertz personnel concerned have the benefit of bitter experience — which must have pretty similar characteristics the world over — and have designed accordingly. Enough. Time to find out about the product.

The Linear 6 series

There are three amplifiers in the Linear 6 series, the 6.1, the 6.2 and the 6.3, all with identical appearance and virtually identical performance specifications, except with respect to power output. All are two-channel (stereo) amps, with bridging facilities for single channel (mono) operation. The 6.1 is rated to deliver 300 W/ch into 4 Ω, the 6.2 to deliver 520 W/ch into 4 Ω and the 6.3, 810 W/ch into 4 Ω; all at 1% THD. I would believe these figures are conservative. Output circuitry employs a rugged set of MOSFETs. Each amp is housed in a standard all-metal 19-inch rack cabinet, measuring overall 483 × 177 × 350 mm. We'll get back to the other specifications of interest shortly.

The front panel is a muted two-tone grey featuring two prominent, black die-cast handles at each end. An escutcheon on the left has rear-lit status and operational indicators which provide information on things like whether the amp is in the normal stereo or bridged mode (mono), if the sub-sonic filters are selected, plus over-temperature and clipping. The power on/off switch, with incorporated bezel, is below this escutcheon. In the centre of the panel are two rotary attenuator controls, calibrated in dB to enable accurate setting of the amplifier's output.

The right hand side of the front panel is taken up with a series of 125 mm long by 3 mm wide slots. This provides the air inlet for the output stage fan-cooled heatsink which is mounted directly behind it and running right through almost to the rear of the chassis. This portion of the electronics is contained entirely in a metal compartment, ensuring the fan draught passes entirely over the output stage heatsink, exhausting through a similar series of slots in the rear panel. The fan itself is mounted between the end of the heatsink and the rear panel slots.

Slotted top and bottom panels provide free-air circulation for the remainder of the electronics, which predominantly involves the power supply and protection circuitry.

While the front panel is a "minimalist" design, the rear panel, like many of its competitors, is chock-a-block with connectors and other facilities. The input for each channel is served by a pair of standard 6.5 mm jacks as well as an XLR socket. The output from each channel is served by twin XLRs along with a pair of heavy duty 15 mm diameter colour-coded binding posts.

Note that the output XLRs are *female* instead of male, as commonly found on competitors' product. This is so that the unit(s) meet German safety authority standards as peak-to-peak output voltages may reach 150-200 volts, a definite hazard. The binding posts feature spring-lift operation for wire or lug entry, and recessed 4 mm sockets for spring-plug terminations. Very neat, indeed.

There are three small push-push operation switches situated between the channel input connectors: the top one provides for floating ground or ground to earth, the centre one for stereo or bridged mode operation and the bottom one switches a subsonic filter in or out. This last shifts the bass end roll-off up to the ▷

Internal view of a Linear 6 amp. The fan-cooled output stage is in the compartment on the right.

40-50 Hz region when selected.

There is also provision for a 25-pin "D" socket on the rear panel. This caters for an option Hertz call a "Remote Diagnostics System" (RDS) which provides for an amplifier operating check by remote monitoring of all operating modes, so you can determine what's happening without being in the vicinity of, or being able to see, the amp. Other options include a voltage controlled attenuator and an input transformer.

Automatic circuit-breakers, instead of fuses, are provided for each output circuit, with relays featuring magnetic spark suppression. The mains input circuitry is also protected in like fashion. The circuit breaker switches are all accessible on the rear panel.

A *monster* toroidal transformer is located inside the unit, on the left, immediately inside the front panel. Four fist-sized electrolytic capacitors totalling 80 000 µF provide power rail smoothing and reservoir. Naturally, a soft-start facility is included. The bulk of the unit's 21 kg weight is contributed by the transformer.

The electronics is built on glass-epoxy pc boards, with high quality 1% metal film resistors, encapsulated polyester and polypropylene capacitors much in evidence. Internal wiring employs ribbon feeder cable and laced wiring harnesses of thick, low impedance cables. The common connections linking the filter capacitors is done with solid copper busbar. Push-fit connectors are used on interboard wiring. Servicing the Linear 6.2 should present few unusual difficulties.

The entire chassis and fittings are clearly designed and built to withstand some "professional abuse." The front handles, I must say are happily not of the "knuckle-grinder" variety, having all rounded edges and corners. The rear panel speaker binding posts, though, are devoid of protection. While I realise this amp will spend most of its "active" life bolted in a rack, on those occasions it happens to be taken out, the terminals risk damage if the cabinet is stood on its rear panel.

The Linear 6.2 boasts some pretty impressive specifications, as the accompanying table shows. The differences between this unit and the others lie in the fairly obvious areas like amplification factor, power consumption, weight an damping factor. Frequency respons slew rate, THD and TIM, crosstalk (char nel separation) and S-N ratio are all top of-the-tree figures.

A five year guarantee is offered (that confidence!), dating from the time of pur chase. Recommended retail price of th Linear 6.2 is $3800.

And so?

Performance-wise, this amp delivers n surprises. It is loud, it is clean, it is easy t drive and it doesn't hiccup on power-u Driven into clipping, it doesn't "hang" c show any other nasty effects, other tha the expected burst of distortion.

On power-up, the soft-start takes som three seconds to operate. The output pro tection relays hold off for a further fou seconds. The "warning" indicators on th front panel - "protect", "clip" an "temp." — glow red when lit, while th others glow a yellow-green. You can te at a glance, from their position in relatio to the power switch bezel, what's hap pening, even from a good distance awa Not so with the attenuator switche though. However, I understand from th proprietor of Hertz Electronics here Norbert Mollers, that the manufacture have new knobs that clearly indicate thei position.

A quick check showed the output ratin to be on the conservative side, althoug this is a difficult measurement becaus you either need a *substantial* dummy loa or to make the measurement very quickly Thank goodness for sample-and-hol multimeters!

The test of a "good-sounding" amplifie is, that it should have *no* sound of its own And the Linear 6.2 certainly seems to liv up to that. At very high levels, it has a de tectable "edge", which is to be expected guess as distortion will rise. In virtuall every other aspect, except for its obviou intended application, this is a hi-fi ampli fier.

Driven into a short circuit, the protec tion merely comes into play. No surprises

The fan is clearly over-rated and run at quite a low "idling" speed. Note that i draws air in through the front panel, ex hausting through the rear panel, which i as it should be.

A couple of minor negative points: th attenuator switches had a distinctl "loose" action, they felt rather flimsy i fact, and I reiterate my earlier commen about the lack of protection for the rea panel terminals.

All in all, the Hertz Linear 6.2 is a we engineered product showing qualit manufacture that should deliver every thing required in the way of performance

Review product supplied by Hertz Elec tronics, 539 Glenmore Rd, Edgecliff 202 NSW. (02)32 3029.

SPECIFICATIONS

Version	6.2
RMS 1 KHz/0.1%THD, both channels active	2 x 320 W/8 Ohm 2 x 520 W/4 Ohm
MONO Bridged mode	1 x 880 W/8 Ohm 1 x 1200 W/4 Ohm
Distortion factor THD	< 0.01 %
Intermodulation TIM	< 0.001 %
Signal to noise ratio	> 103 dB (A)
Crosstalk	> 70 dB
Frequency response with input filter 130KHz	18/40 Hz - 130 KHz
Frequency response without filter	18/40 Hz - 400 KHz
Rise time without filter with filter	0.9 µs 2.7 µs
Slew rate without filter with filter	127 V/µs 43 V/µs
Amplification	34
Damping factor	> 330
DC offset	> 10 mV
Input sensitivity	1.55 V (+ 6 dBm)
Input impedance electr.bal./unbal.	15 KOhm
LED displays	Subsonic, Stereo, Bridge Signal present input A/B Temperature high A/B Protect A/B, Clip A/B
Operating mode switches	Power ON, Input attenuators A/B Ground lift, Subsonic, Stereo/Bridgemode
MAINS	240 Vac +/- 10%
Power consumption	1500 VA
Soft start	7 A
Dimensions	483 x 177 x 350 mm (19"/4 PU)
Mounting dimensions	445 x 174 x 400 mm
Weight	21 kg

Looking for crystals for the AEM3520 Weather Satellite Receiver?

Popularity of this project seems to have grown somewhat since we published it in the February issue this year, and interest in the APT (automatic picture transmission) weather satellites seems to have grown apace, too.

We don't know which event preceded the other, but we're happy that's happened. However, we have been receiving calls about where crystals might be obtained and what the suitable satellite frequencies might be.

Well, Stewart Electronic Components of Melbourne are able to supply crystals to suit the satellite channel or channels you're interested in. We might also add that this stage that, if you've been considering building this project but haven't got around to getting the bits yet, Stewart Electronic Components can supply a complete kit.

We published details on some of the APT weather satellites in the July '86 issue of *AEM*, page 7, but for those who don't have a copy for reference, we'll repeat the essentials here.

Probably the most popular are the American NOAA series of satellites. They can be found on three channels: 137.50, 137.62 and 137.77 MHz.

The Russian METEOR and COSMOS series of satellites can be heard on these three channels: 137.30, 137.40 and 137.85 MHz.

Three other channels might also be of interest. On 136.62 MHz you'll find GEOS3, on 136.50 MHz there's NIMBUS4, and on 136.80 MHz, you'll find EGRS13 passing over every 107.2 minutes.

When ordering, all you need to do is quote the **channel frequency** you wish to receive on and Stewart Electronic Components will obtain a suitable crystal for the receiver's local oscillator, 10.7 MHz below the channel frequency. Crystals will cost you around $20 each, plus $2 pack and post.

So, for your crystal requirements, call **Stewart Electronic Components, 44 Stafford St, Huntingdale (PO Box 281, Oakleigh) 3166 Vic. (03)543 3733.**

Burn 'em up!

Dick Smith Electronics has just released a nifty new tool for hobbyists and home handypersons (. . . we'll let that go, - Ed.) who find the occasional need to apply a little heat to "the subject" being operated on.

It's a pocket-sized or "pencil" butane-operated "torch", dubbed *The Blue Blazer* because of its bright blue handle. The handle serves as the fuel container and there's a twist-action flow control at the 'business end'.

The tiny burner will produce a flame that is variable from a tiny pin-point to full flame about 7-8 mm diameter. It may be used for soldering, brazing, silver-soldering, melting glass tubing, heating thermoplastics, etc.

The fuel is standard household butane — cigarette lighter fuel. The Blue Blazer is only 200 mm long by 13 mm diameter. We obtained one to try out around here and found it quite simple to use; it's ideal for small jobs requiring intense localised heat. See your local Dick Smith store or stockist.

Multi-pin locking connector

Melbourne-based retailer, All Electronic Components, is always good for a "bargain" in odd and hard-to-get parts. One a visit to Melbourne earlier in the year we had a good rummage among the bargain bits in their Lonsdale Street store in the city and came up with dozen or so useful components.

One item that took our eye was an 8-pin metal barrel plug and socket set made by German manufacturer, Preh. This features a secure locking action provided by a captive locking ring; a half-twist clockwise locks it, the opposite action unlocks it.

The plug has a rubber cable strain boot and solid, machined pins. The socket has bifurcated (split) socket pins and a wiper finger for contact with the metal plug casing. The socket is a panel-mount type.

The plug costs $3, the socket just $1. Make solid connection with **All Electronic Components, 118 Lonsdale St, Melbourne 3000 Vic. (03)662 1381.**

LM833s, and other National delights

The device featured in this month's Data Sheet (pages 124-128), the LM833 high performance audio op-amp, was released by National Semiconductor in 1984, but has only come to prominence this year. Bit of a "sleeper", eh?

The device is featured in this month's Star Project, Dick Smith Electronics' Budget Stereo Control Preamp. Doubtless it will turn up in more project designs as time goes by. It looks set to displace the 5534 in many applications, another high performance audio op-amp popular since 1980. What's more, the LM833 is a dual device.

We've been specifying quite a number of neat National Semiconductor devices in projects recently. And with good reason. They do the required job, they're reasonably priced (if not *fantastically* priced!) and generally readily available.

The National Semiconductor range is very wide and very varied, "comprehensive" would be the best description. If you're rummaging around looking for suppliers of non-run-of-the-mill "Nat-Semi" devices, or even the common ones, there are two good firms that should be on your port-of-call list: Geoff Wood Electronics in Lane Cove, Sydney, and Stewart Electronic Components in Huntingdale, Melbourne.

Of the four "major enthusiast retailers", Ritronics in Melbourne carries the widest range of Nat-Semi devices. A quick consultation in their catalogue will show you that.

PROJECT BUYERS GUIDE

The **AEM5510 Night & Day Relay** has a host of practical applications. And it's inexpensive. It was designed to be able to use a variety of optoelectronic devices — an FPT100 phototransistor, a BPW50 photodiode or an ORP12 LDR. Fortunately — no, deliberately! — all are widely available. Dick Smith Electronics, for example, stock all three! But, instead of the ORP12, they stock an equivalent — the DSCD01. The 741 op-amp is also widely available as a stock-standard item. And we've never found an electronics retailer yet that doesn't stock at least one of the opto devices specified.

The Star Project this month, the **Budget Stereo Control Preamp** is being sold as a 'basic' kit, cat. no. K-3045, without the on-board power supply components, but including a front panel (the one from the Low Cost Stereo Amp, in AEM August 1987, K-4001). The optional components are all stock lines. At $89.95, this project has to be a bargain with the performance it achieves. And this month, DSE are also offering the case to suit, cat. no. H-2900, for just $27.95, down from $34.95.

Amateurs — build this low-cost colour TV transmitter

Part 1

Bob Reid VK3AWL
Howard Rider VK3ZJY

This is the ideal project for "getting into" TV transmission on the amateur bands. It's economical and easy to build and get operating because it's a well-proven design put together by experienced "ATVers".

THIS PROJECT has been developed so that you can completely build a television transmitter for operation on the 70 cm band ATV channels (426.25 MHz and 444.25 MHz), complete with intercarrier FM sound at 5.5 MHz, using only a multimeter for alignment!

To achieve this, you build all the test equipment you need - three simple wavemeters with etched inductors; your multimeter's used as the indicator. These not only allow easy checking and alignment, but eliminate the possibility of tuning the exciter to the wrong frequency. A television set with UHF tune also makes a dandy test instrument — and most household have one on-hand!

Four sections comprise the complete transmitter project, eac contained on a separate printed circuit board module. The fo modules are:

- the RF exciter
- the video modulator
- the sound (audio) modulator, and
- the linear amplifier.

As the power supply required is a nominal 12 Vdc, the transm ter can be used portable and powered from your vehicle's 1 battery, or at home, powered from a suitable 12-14 Vdc ma supply.

A block diagram of the basic transmitter (sans linear

The authors are marketing a complete kit for this project. All components, pc boards, the case and heatsink are supplied. This overcomes the risk of inexperienced constructors using unsuitable components (e.g: incorrect physical size or wrong value, or rating etc). Enquiries should be directed to 232 Cumberland Rd, Pascoe Vale 3044 Vic.

The complete transmitter is housed in a roomy instrument case, locally made by Horwood, measuring 205 mm wide by 200 mm deep by 100 mm high. The socket at lower right is a standard video socket that accepts the connector from most domestic video camcorders. Video and audio are obtained directly from the camera; the camera may also be powered from the transmitter supply if you wish.

FEATURES

- Simple, straightforward design
- Operates on the 70 cm band
- Intercarrier FM sound at 5.5 MHz
- Modular construction, easy to build
- Align it with just a multimeter
- Excellent picture and sound quality
- Low cost

nown here. Note that the project has been designed for colour ansmissions as colour video cameras and camcorders are more ommon than monochrome units in amateur circles these days. The RF exciter is based on a very successful earlier design in se by a number of ATVers, produced by Ian VK3ATY and oward VK3ZJY. This current design features a modified final age. The exciter produces 100 milliwatts peak output which is eal for driving a "block" wideband RF linear power amplifier odule, such as the Mitsubishi M57716, which we have used in is project. This will raise the output to around 5 W under deo modulation.

That's quite a respectable power level in ATV terms. A video ansmission occupies a much wider bandwidth than a typical m or 70 cm voice FM transmission, for example, so that more nergy is being transmitted than a 5 W FM signal. When fed to a good Yagi antenna, the 5 W from this transmitter will ve good TV signals over similar distances to a 10 W FM transitter fed into a ¼-wave whip antenna.

The video modulator was designed by Mike VK3YOV and nsures a good quality picture under widely varying light levels the video. The sound modulator takes in line level audio dict from the camera which eliminates frame buzz problems enerated in low level, high gain audio stages.

The transmitter case is fitted with a standard camera connecr socket so that audio and video from a domestic video camorder is conveniently obtained. The camera can also be supied with 12 Vdc power from the transmitter.

The off-air picture and sound quality delivered by this transitter has proved excellent as reported from numerous units aldady constructed and in use.

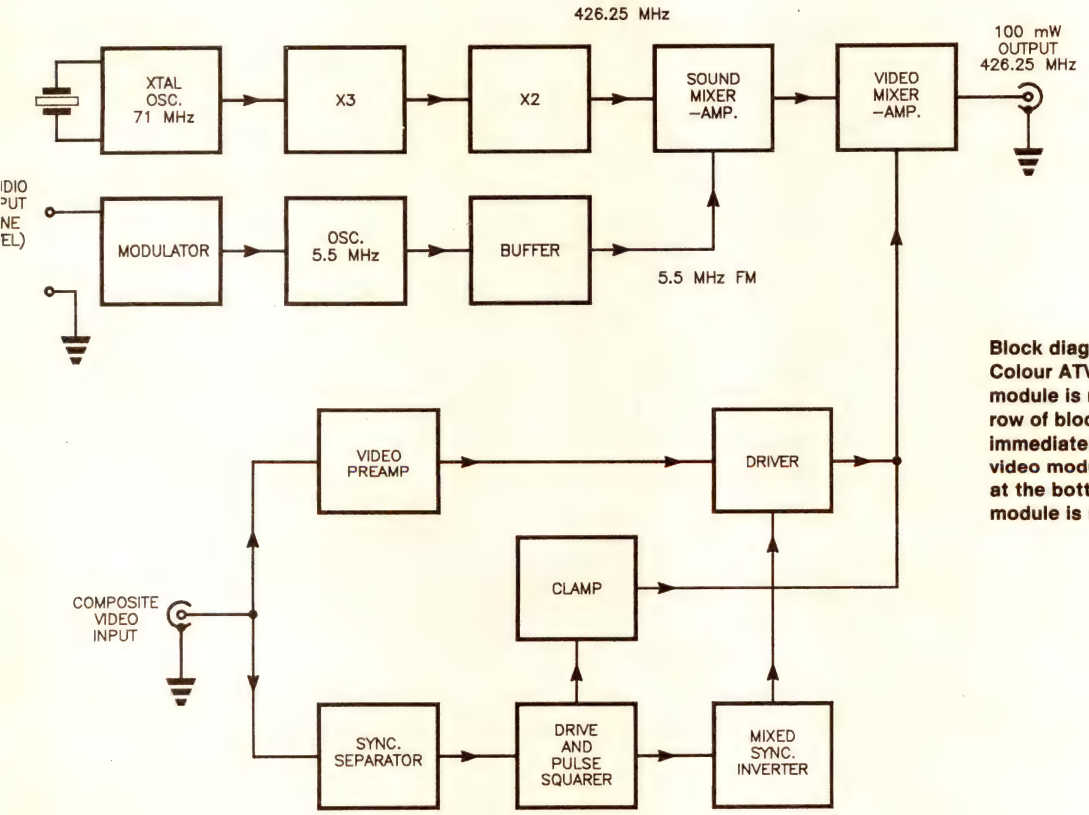
Now you've got a good idea of the overall picture (no pardons for the pun!), let us take a detailed look at the circuitry. We'll get into the nitty gritty of construction in Part 2, next month.

The RF exciter

The block diagram shows this module to have five stages, each of which is identified on the circuit here. Four low-cost NPN VHF/UHF transistors, type PN3563, are used with a BF960 UHF dual-gate FET in the final stage. The PN3563 is ideally suited to the applications here, being described in the data sheet as "... designed for use as RF amplifiers, oscillators and multipliers." The PN3563 has a gain-bandwidth product (f_T) over 900 MHz so it's well within its capabilities here.

For the sake of example, this description is confined to transmitter operation on 426.25 MHz, although the project will readily operate on 444.25 MHz.

The oscillator stage, built around Q1, employs a 71.0416 MHz overtone crystal which the two following stages multiply to the final output frequency of 426.25 MHz. The circuit is an "overtone oscillator," with Q1's base being effectively "grounded" *only* at the crystal frequency, providing the required feedback for oscillation in this circuit. The crystal operates at *series resonance* which presents an extremely low impedance, hence grounding the gate. It has more than one series resonance, starting at the fundamental, but here the tuned circuit in the collec- ▷



Block diagram of the basic AEM3515 Colour ATV Transmitter. The exciter module is represented by the top row of blocks, the sound module is immediately beneath it, and the video module is the group of blocks at the bottom. The linear amplifier module is not shown here.

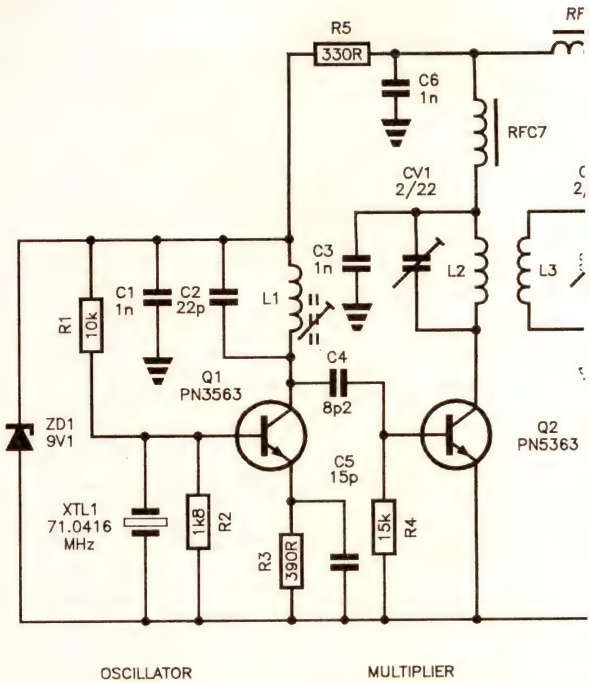
tor resonates at the crystal's 71 MHz overtone frequency so that only feedback at that frequency matters. A slug-tuned coil is used to adjust L1-C2 to resonance.

The oscillator stage's collector voltage is stabilised by ZD1, a 9.1 volt zener, to ensure supply rail variations do not affect the oscillator frequency and thus cause drift in the output frequency. A small change here is multiplied six times at the output! The dropping resistor supplying current to ZD1 and Q1's collector is R5. C1 bypasses the collector circuit of Q1 and R1-R2 provide its base bias.

Output from Q1's collector is coupled into the base of Q2 via a small value capacitor, C4. Transistor Q2 is a Class C multiplier, tripling the input frequency at its collector. "Class C" here means that the collector current in Q2 flows for very much less than 180° of each positive-going input half cycle. No base bias is required. R4 provides a load for the energy coupled from Q1's collector while Q2's base is not conducting. The collector circuit is tuned to 213 MHz with CV1-L2. Here, and from here on, the tuned inductors are all air-wound, self-supporting coils. Q2's collector circuit is decoupled via RFC7-C3.

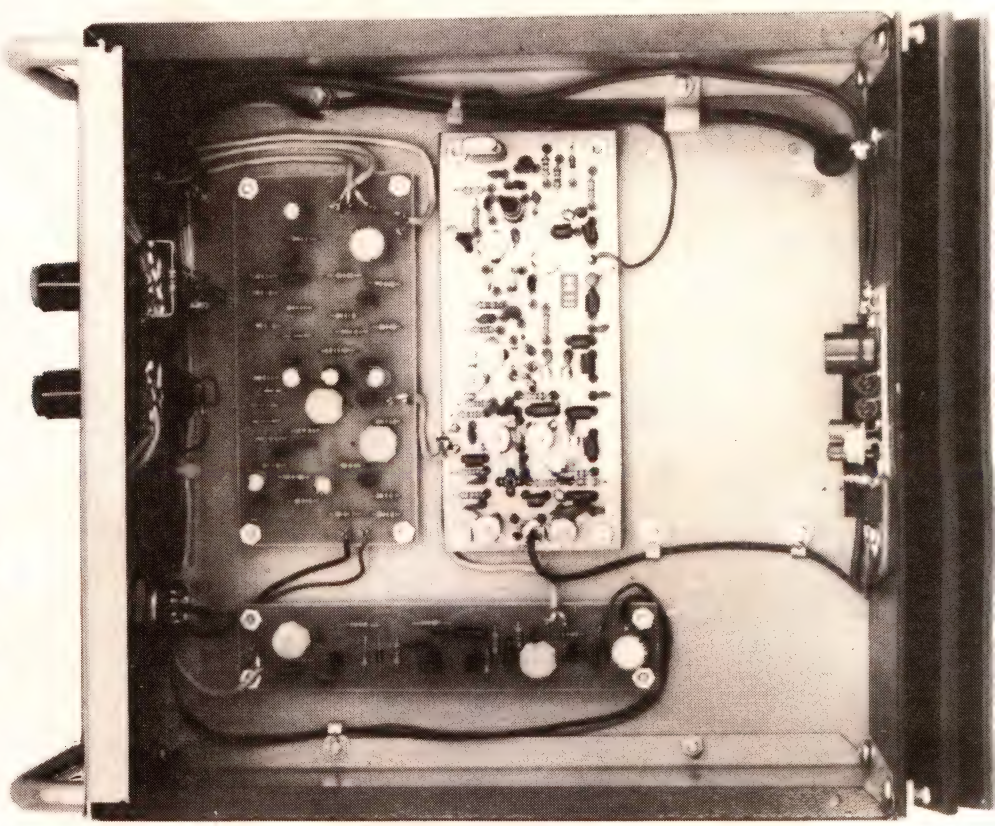
The next stage, involving Q3, is a doubler, output being on 426.25 MHz. Here, Q3 has a small amount of base bias applied, which improves the stage's sensitivity. Being a doubler, it has greater efficiency than a tripler would here, and you need all you can get once you reach 420 MHz! Energy from Q2's collector tuned circuit is inductively coupled into Q3's base via a tuned circuit comprising CV2-L3, the latter being mounted in close proximity to, and on the same axis as, L2. C9 provides dc isolation for the base bias, which is provided by R6-R7. Emitter bias is provided by R8, which is RF-bypassed by C11.

This stage's collector is tuned by CV3-L4. Note that, instead of an RF choke, a small ferrite bead ("bead 1") is used in conjunction with C8 to decouple Q3's collector circuit. The ferrite bead is slipped over a short length of tinned copper wire link

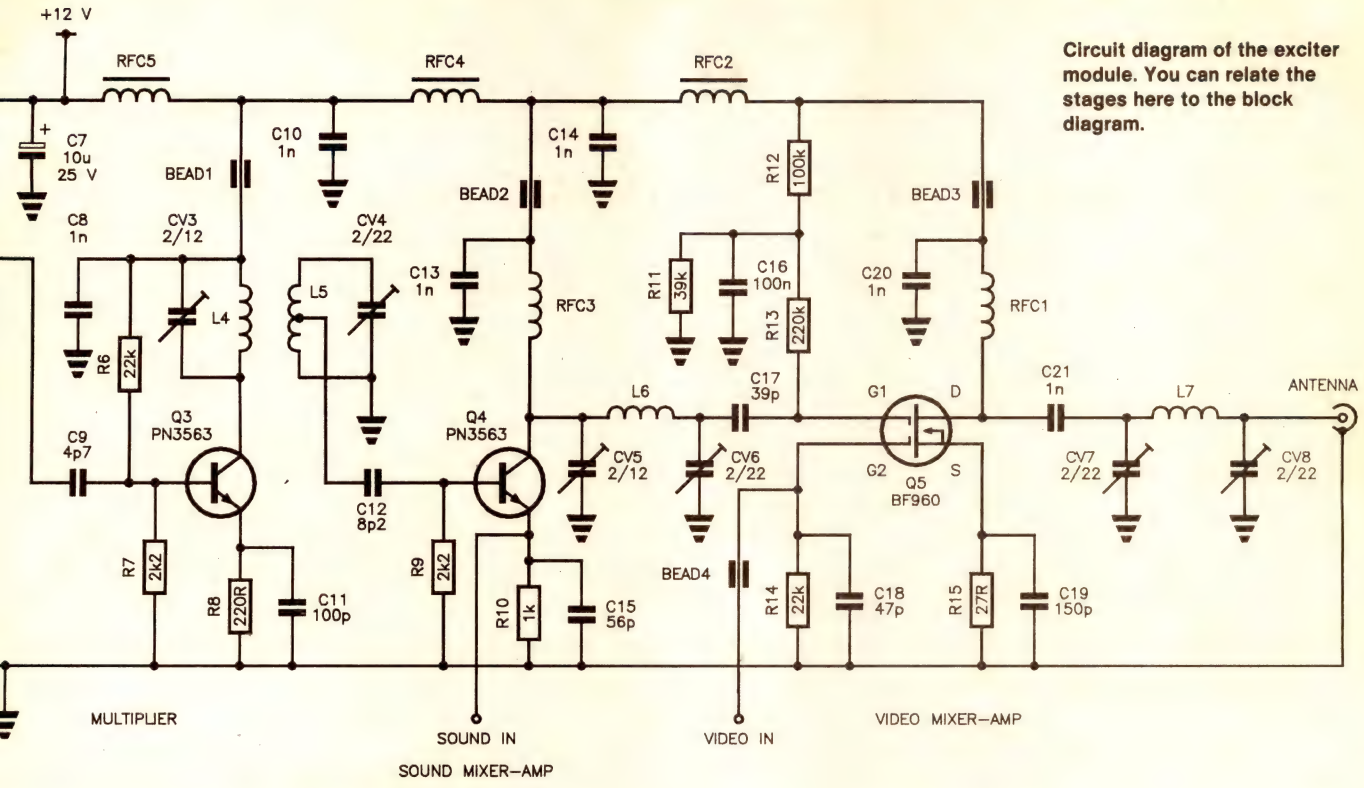


and this provides all the necessary inductance. The same technique is also used to decouple the collector circuits of the final two stages.

The next stage, involving Q4, is the sound mixer. The video carrier frequency at 426.25 MHz is coupled into Q4's base via tuned circuit CV4-L5. Here, as with L2-L3, L5 is coupled to L4



Internal view of the project. The RF exciter module is in the middle; the long narrow board at the bottom is the sound modulator, while the video board is to the left of the exciter. On the rear panel you can see the linear amplifier module, which is cooled by the heatsink you can see attached to the rear. Shielded cables link the video and audio signals; coax links the exciter and linear, and the linear to the antenna connector.



Circuit diagram of the exciter module. You can relate the stages here to the block diagram.

by being mounted in close proximity, and on the same axis. The base of Q4 is coupled to L5 via C12 which is "tapped down" the coil to provide the required amount of base drive and reduce loading on the tuned circuit in order to keep its Q up. R9 provides a load when Q3's base is not conducting.

The 5.5 MHz intercarrier sound is injected into Q4's emitter, modulating the collector-emitter signal current. Q4's emitter is bypassed at 426 MHz by C15 which has a relatively high impedance at 5.5 MHz. The sum and difference frequencies of the carrier and sound signals — 431.75 MHz and 420.75 MHz - appear at Q4's collector, as "sidebands" to the 426.25 MHz carrier. The collector supply is "shunt-fed" via RFC3, an air-wound self-supporting choke, the 426.25 MHz video carrier and FM sound carrier mixed at the collector being passed to the final stage via a pi-matching network comprising CV5-L6-CV6. This network also provides a low-pass filter function, which gives some attenuation of harmonics above the output frequency.

The final stage, Q5, is a BF960 dual-gate MOSFET, a high performance device for VHF/UHF applications. This comes in a special *stripline* package to reduce lead inductance. Output from the Sound Mixer-Amp stage is coupled into gate 1 of Q5 via C17 which provides dc isolation. A bias of some 3.3 volts is applied to gate 1 via R13, derived from the voltage divider formed by R11-R12. C16 bypasses the bias point.

The incoming composite video (that is, video signal and sync pulses) is impressed on gate 2 of Q5. A ferrite bead here, situated close to gate 2, decouples any stray RF energy from passing *back* to the sound modulator. R14 provides a dc return for gate 2, bypassed at 426 MHz by C18 which is a relatively high impedance at the highest video frequencies encountered. Source bias for Q5 is derived from the drain-source current flowing through R15, which is bypassed by C19. The drain supply is shunt-fed via RFC1 and the collector matched to a 50 Ω load by a pi-matching network comprising CV7-L7-CV8. C21 provides dc isolation.

The composite video signal applied to gate 2 of the BF960 modulates the drain-source channel width, thereby modulating the drain-source signal current. Hence, quite a complex signal appears at the drain of Q5, containing all the information we wish to transmit!

The output is marked "antenna" because you can put the signal here straight to air with good results across-town using a beam antenna of reasonable gain. In this project we have followed the RF exciter with a linear power amplifier which shall be described later.

A fairly detailed tune-up procedure has been written for this module. When you get to this stage following construction, provided you follow the suggested procedure, the exciter will present no problems as it is very "tame."

Each stage is individually decoupled along the supply rail by a series of RF chokes, formed by a few turns of wire around ferrite beads, and associated 1n bypass capacitors. A 10μ tantalum capacitor (C7) provides a general bypass at the 12 Vdc supply rail input.

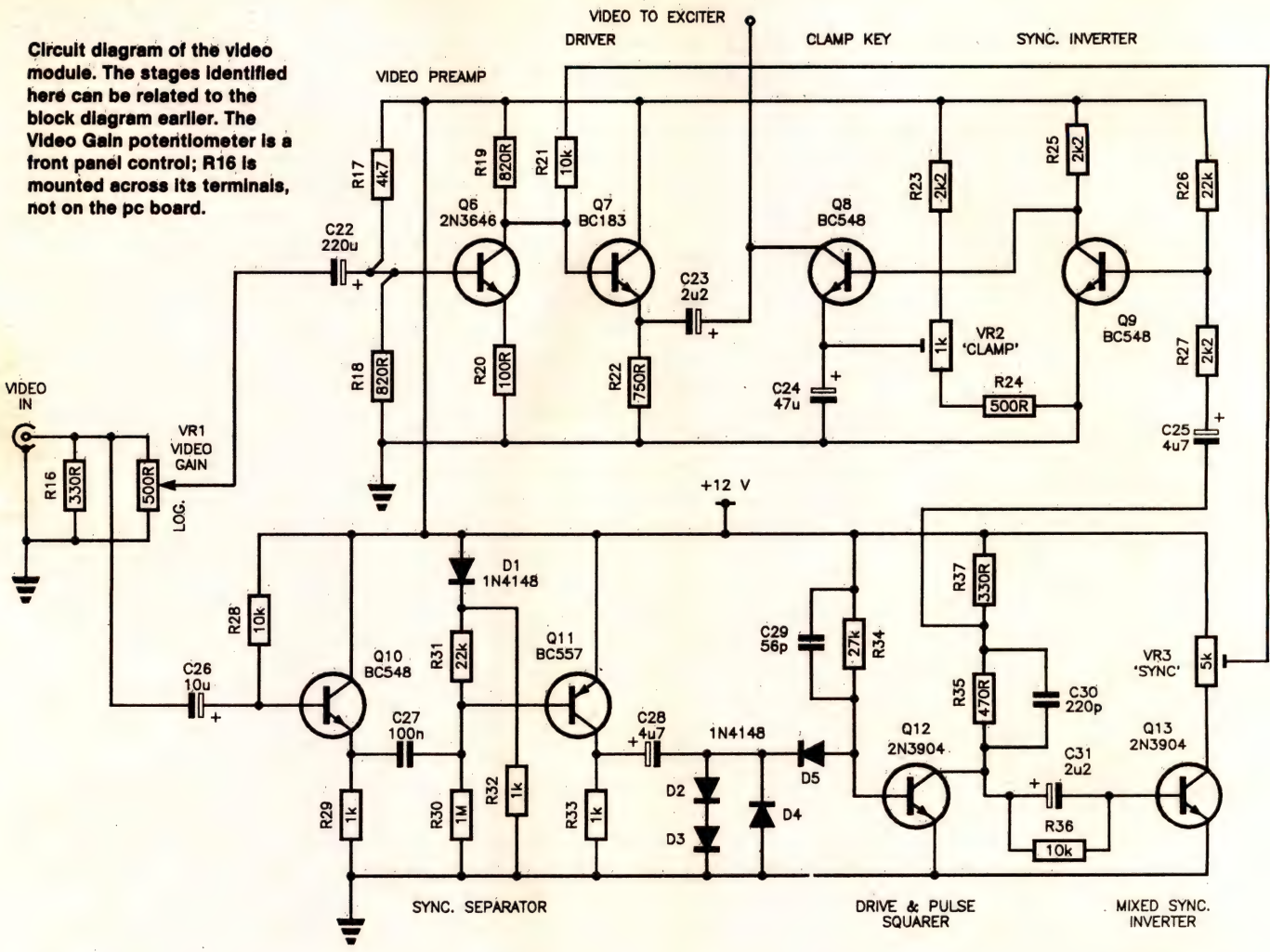
The video modulator

For its apparent simplicity, this module does a remarkably good job of providing steady sync pulses and good video signals despite wide variation in the incoming video signal from the camera. For those familiar with a little television system technology, this modulator features "back porch" clamping so that the sync/video relationship does not vary under varying video levels. A most desirable attribute for obtaining good signals off-air.

Composite video is obtained from the camera. That is, the video signal has the line and frame sync pulses mixed-in with it. This circuit splits off the sync signal and *regenerates* them. They are then recombined with the video, which has been amplified, before passing to the final stage of the RF exciter.

The incoming video is split two ways: to the video preamp and to the sync separator. A potentiometer, VR1 — the front panel control labelled "video", provides for some control of the video level. The base of the video preamp, Q6, is capacitively coupled to the wiper of VR1. A large value capacitor is used here because the impedance is relatively low and low frequency signals must be passed. Q6 provides a gain of 8 ×, its collector being directly coupled to the base of Q7, the driver, to which we shall return shortly.

Incoming video is also passed, via C26, to the base of Q10, an emitter follower. Its output is capacitively coupled to the base of Q11 via C27. Now the base of Q11 is not normally conduct- ▷



Circuit diagram of the video module. The stages identified here can be related to the block diagram earlier. The Video Gain potentiometer is a front panel control; R16 is mounted across its terminals, not on the pc board.

ing because it is prevented by the ~0.5 V forward conducting voltage of D1, which is forward biased by R32. The sync pulses coupled from the emitter of Q10, which are *only* negative-going — the video signal being positive-going, will thus provide base current pulses for Q11, its consequent collector current pulses appearing across R33. Thus, the sync pulses are separated from the video.

The pulses at Q11's collector are then coupled via C28 to a diode clipper comprised of D2-D3-D4. Diodes D2-D3 clip the positive pulses to 1.2 V and the negative pulses to about 0.5 V. The positive pulses will allow Q12 to turn hard on, while the negative pulses will turn it right off as its base will be "pulled" to virtually zero volts because the base bias current from R34 will be diverted via D5 and D4. C29 effectively 'speeds up' the switching of Q12's base.

The pulses at the collector of Q12 are directly coupled to the base of Q13 which inverts the pulses at its collector, returning the now-regenerated sync pulses to their correct sense. The collector load of Q13 is trimpot VR2 which permits adjustment of the sync amplitude. This control's wiper is linked directly to the base of the driver, Q7, via R21. Thus, Q7 receives both its base bias and the sync pulses from the collector circuit of Q13.

The collector load of Q12 comprises two resistors, R35 and R37, which permits the sync pulses here to be 'tapped off' for passing to the clamp key circuit. The pulses are first inverted by Q9, its collector being directly coupled to the base of Q8. Now the emitter of Q8 is biased-up to a few volts from the wiper of VR2, part of a voltage divider across the supply rails involving R23 and R24. VR2 permits variation of Q8's emitter voltage from about 1.5 to 5 V. C24 is an ac bypass for the emitter of Q8.

The video and regenerated sync pulses appear at the emitter of Q7. The composite video being coupled to the video modulation input of the RF exciter. At each sync pulse, Q8 turns on, 'clamping' the output level at the dc voltage set by VR2, the clamp trimpot.

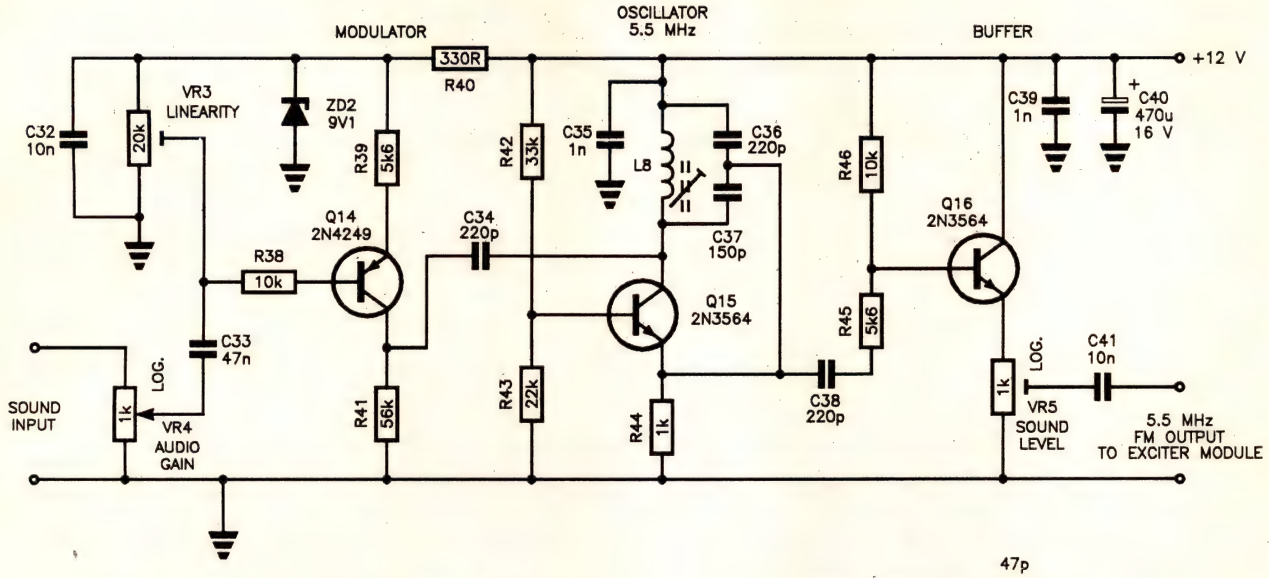
The sound modulator

This module is remarkably simple and works remarkably well! As can be seen from the block diagram, it comprises three stages: the modulator, the 5.5 MHz oscillator and a buffer.

High level audio input from the camera's microphone comes into the "sound input", VR4 enabling level setting for the audio. This is the front panel control labelled "audio." The audio is capacitively coupled to the base of the modulator, Q14, via C33 and R38. Bias is applied to the base of Q14 from VR3, the "linearity" control. We'll see why it gets this name shortly. First, though, we'll need to examine the oscillator.

The 5.5 MHz sound carrier is generated by Q15, connected here as a Colpitts oscillator. The frequency is determined by the tuned circuit formed by L8 and C36-C37. The resonant circuit's tuning capacitance is "tapped" to provide the required feedback. Note that C36-C37 are special high stability "dipped" mica capacitors to ensure adequate temperature stability of the oscillator. Base bias for Q15 is applied via the R42-R43 voltage divider. C35 bypasses the supply rail at Q15's collector.

The collectors of Q14 and Q15 are coupled via C34. The incoming audio modulates the base-collector voltage of Q14. This effectively modulates the b-c bias voltage which, in turn, modulates the transistor's collector-emitter *capacitance*. The capacitance *swing* is quite small, only about 1.5 pF or so, but this has quite an effect on the 5.5 MHz oscillator frequency. It works



The sound module circuit diagram. Note that C36 and C37 are high stability dipped mica capacitors. The Audio Gain potentiometer is a front panel control.

is way: the effective capacitance of C36-C37 is about 90 pF. A wing of 1.5 pF represents about a 1.7% change in frequency, or deviation of about 50 kHz. Just what we want!

The modulator's collector voltage, and its base bias, is stabised by ZD2, a 9.1 volt zener. R40 is the dropping resistor for D2's bias current and Q14's collector current. C32 is Q14's supply bypass.

The collector-base capacitance change with base-collector oltage swing is a non-linear curve when taken as a whole. owever, over a small portion of the curve, determined by the llector-to-base bias voltage, the c-b capacitance variation will e relatively linear. Hence the necessity for VR3.

Output from Q15 is coupled to the base of the buffer, Q16, om the emitter load, R14, via C38 and R45. The latter ensures "light" load on the oscillator's output. Q16 is an emitter follower, the emitter load being a trimpot, VR5, which is dubbed ound level". The wiper of this control is capacitively coupled the emitter of Q4, the sound mixer-amp in the RF exciter odule. Base bias current for Q16 is provided by R46.

General supply rail bypassing is provided by C39 and C40.

ie wavemeters

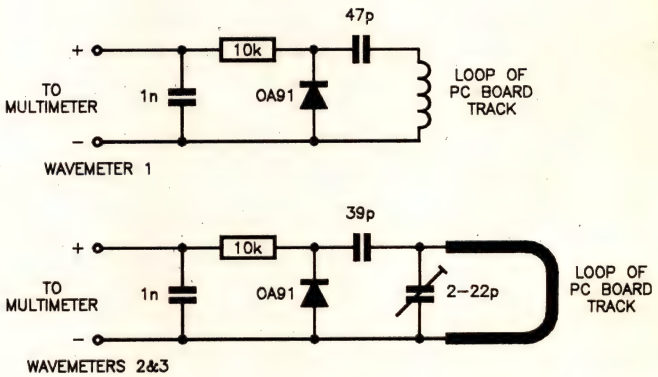
ie accompanying circuits show the general arrangement of e three wavemeters. Note that wavemeters 2 and 3 are the me. Each has a "coil" which is simply a length of track etched the pc board. This allows them to be readily coupled to the ned circuit coils of the stage under test. As the photograph ere shows, they are fabricated on narrow strips of pc board, easuring 15 × 80 mm.

Wavemeter 1 is a series resonant pickup loop capacitor-upled to a half-wave peak rectifying detector using an OA91 ermanium diode. It is tuned to about 70 MHz. Note that it has a le in the board situated in the middle of the loop. This allows to be lowered over the slug tuned coil L1 in the RF exciter in der to gain sufficient coupling.

Wavemeters 2 and 3 comprise parallel resonant loops pacitively coupled to the same sort of rectifier as used on avemeter 1. A small trimmer sets each wavemeter frequency. Vavemeter 2 tunes around the 210-220 MHz region, while avemeter 3 tunes around the 420-440 MHz region.

oming up

rt 2 gets to the "good bits", constructing the project. Bet you n hardly wait!



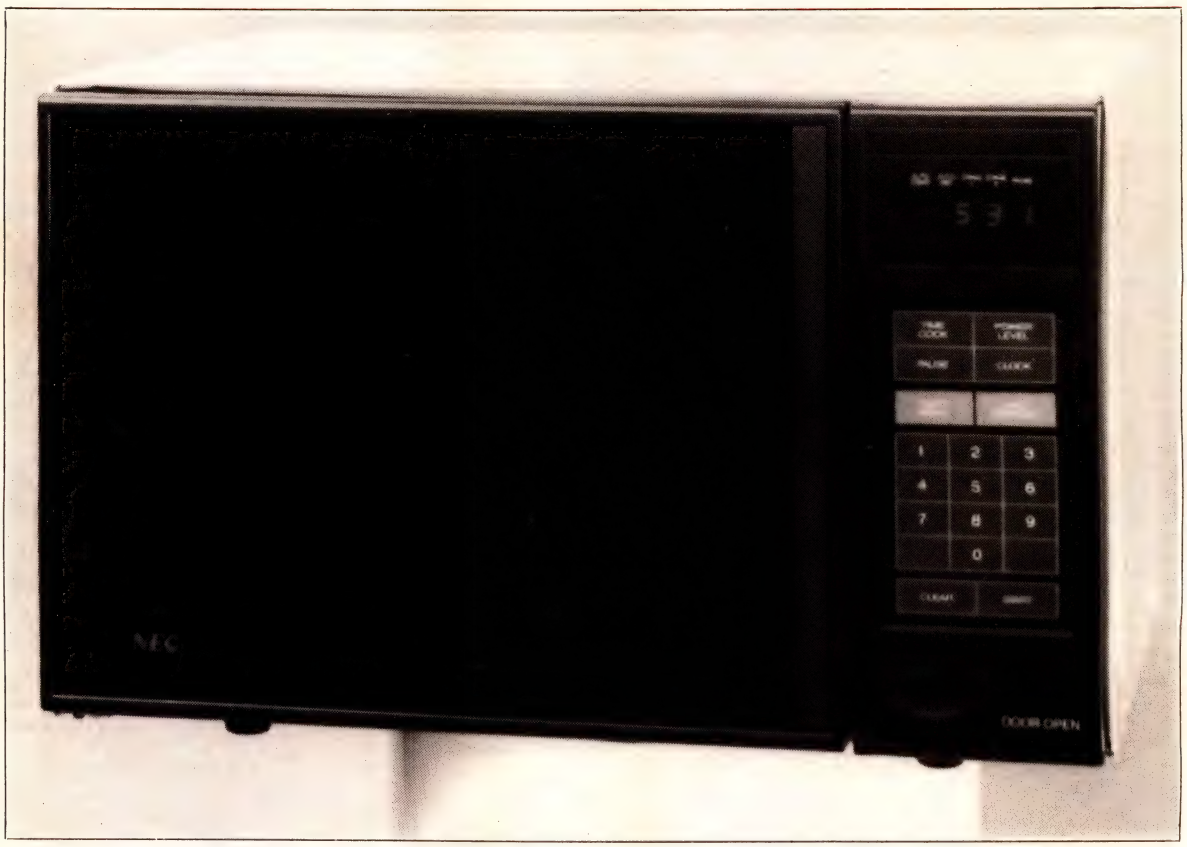
Three wavemeters are used to tune-up the exciter. Your multimeter is used as an indicator — an ordinary analogue type is best, or a simple milliammeter. The size of the pc board loop and the value of the associated tuning capacitor sets the frequency of the wavemeter.

The three wavemeters — 1, 2 and 3, from left to right.

3RD BIRTHDAY CONTEST No.2.

Slave over a hot soldering iron, not a hot stove!

Win this NEC Microwave Oven!



You would, of course, prefer to spend more time on interesting pursuits than at functional activities such as making meals. Unless making meals is a more interesting pursuit, that is!

Well, Adelaide electronics retailer, Eagle Electronics, has presented you with this dilemma – er, fabulous prize, a top-line microwave oven by NEC. Win this and you'll be able to whip up a quick snack so you can return to that project on the bench, or whatever.

This NEC microwave features all the latest control tricks with it's microprocessor operated control panel. And it's a cinch to operate!

Of course, if you don't want it in the workshop, you could always endear yourself for ever to the rest of the household and donate it to the kitchen!

1) Heart of the microwave oven is the "magnetron", a high power 2.5 GHz oscillator. Name the two men who developed the "cavity magnetron"?

. . . . . .

2) What is NEC's "company slogan"?

. . . . . .

3) Eagle Electronics has an associated company in the kit business. What's its name?

. . . . . .

In 25 words or less, describe the first meal you'd like to cook in this NEC microwave oven.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

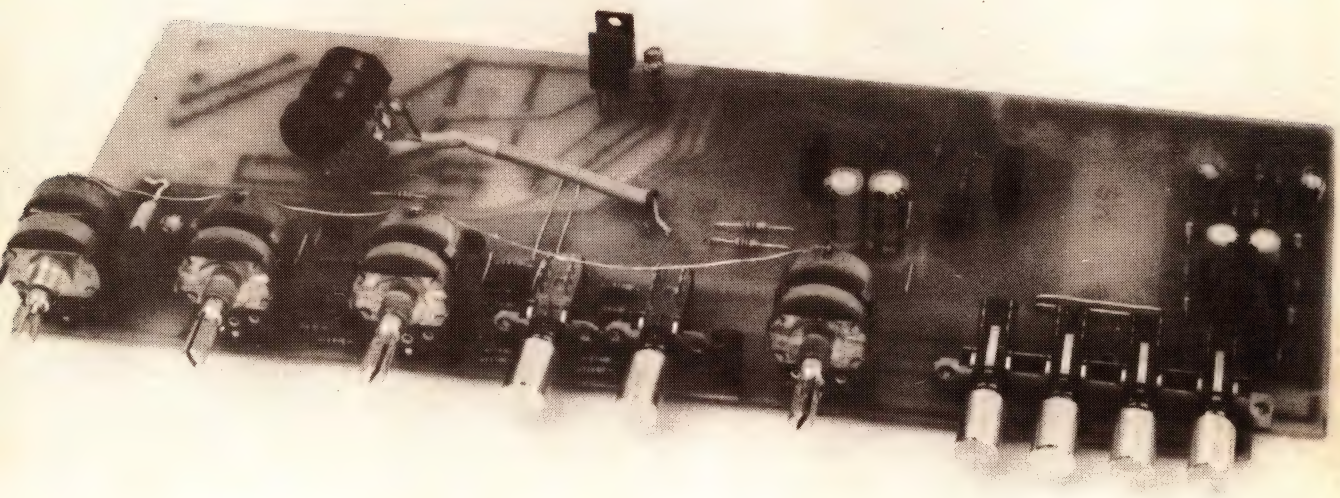
Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

CONTESTS CLOSE 31 OCT. 1988



High performance, low-cost stereo preamp/control unit

Dick Smith Electronics

This project is for the audio enthusiast on a budget or for the audio experimenter who doesn't want or need a preamp with all the expensive bells and whistles". It can be built into an existing amplifier or as a stand-alone unit. Good performance is ensured through the use of a relatively new high performance op-amp, the LM833.

AUDIO POWER AMP KITS have been an extremely popular item with enthusiasts for well over a decade now. The best selling ones over that time have been the 50 W and 100 W amplifier modules based on that most popular of bipolar power transistors, the 2N3055. These modules are bought to be used in a variety of applications: PA amps, guitar amps and home stereo setups. While various preamp kits to suit PA and guitar amp applications have been available, there has long been a demand for a "stand-alone" stereo control preamp for application with these popular power amp modules.

Resourceful constructors over the years have pressed into service all sorts of preamp modules and kits for use with power amp modules they've elected to use in a stereo setup, but there's been nothing available as a stand-alone unit - generally preamp for another application or setup has been pressed into

LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

SPECIFICATIONS

Rated Output ..... 1 V RMS into 10 kΩ

Input Sensitivity
Phono ..... 3.2 mV RMS
Line ..... 178 mV RMS

Phono Overload ..... 133 mV RMS

Signal Noise/Noise Ratio (at 1 khz, flat)
Phono: -75 dB referenced to 10 mV RMS input
Line: -80 dB referenced to 200 mV input

Frequency Response
Line Inputs ..... -2.5 dB @ 20 Hz; -0.5 dB @ 20 kHz
Phono Stage ..... RIAA/IEC equalisation within ±2 dB (30 Hz to 15 kHz)

Tone Controls
Bass ..... 60 Hz, ±12 dB
Treble ..... 15 kHz, ±13 dB

Stereo Separation
Line ..... -70 dB
Phono ..... -68 dB

service. Not always a wholly satisfactory arrangement.

Well, this project corrects that situation and "fills the gap" for those many enthusiasts who like to experiment with their stereo setup and "mix-n-match" various modules involved in the equipment. It is ideal for use with the 50 W and 100 W bipolar amplifier modules, DSE kits K-3440 and K-3442 respectively, or the more recent MOSFET output 60 W and 120 W amp modules, DSE kits K-3441 and K-3443 respectively.

General description

This is a fully self-contained stereo preamp control unit, including all the usual controls you need:

- volume
- bass
- treble
- balance
- input selection switching
- tape monitor switching
- mono/stereo switch.

The balance and tone control potentiometers specified all have a detent at the centre position and the volume control has a d tent "clicker plate" for step-level setting. The tape monitor ar mono/stereo pushbuttons act independently, while the four i put selection switches are linked so that only one source ma be selected at any time.

The unit has provision for the following input sources:

- phono, magnetic cartridge
- compact disc player
- tuner
- tape
- auxiliary;

and provision for the following outputs:

- tape
- line
- headphones.

Refer to the specifications for sensitivity, line output levels ar other details. A LED is provided for "power on" indication.

The phono and high level input stages employ a relative new high performance dual audio op-amp IC, the Nation Semiconductors LM833. This features low distortion (typical

CIRCUIT DETAILS

A). SW1a/b/c/d connect one of four inputs (phono, tuner, CD, auxiliary). SW2 connects the tape input. The inputs are directly coupled through R8/R108 to VR1/VR101 (volume control) in the input preamp stage.

B). SW2 enables phono, tuner and CD inputs to be recorded while you are monitoring the output — "SOURCE" position, or without monitoring the output — "TAPE" position.

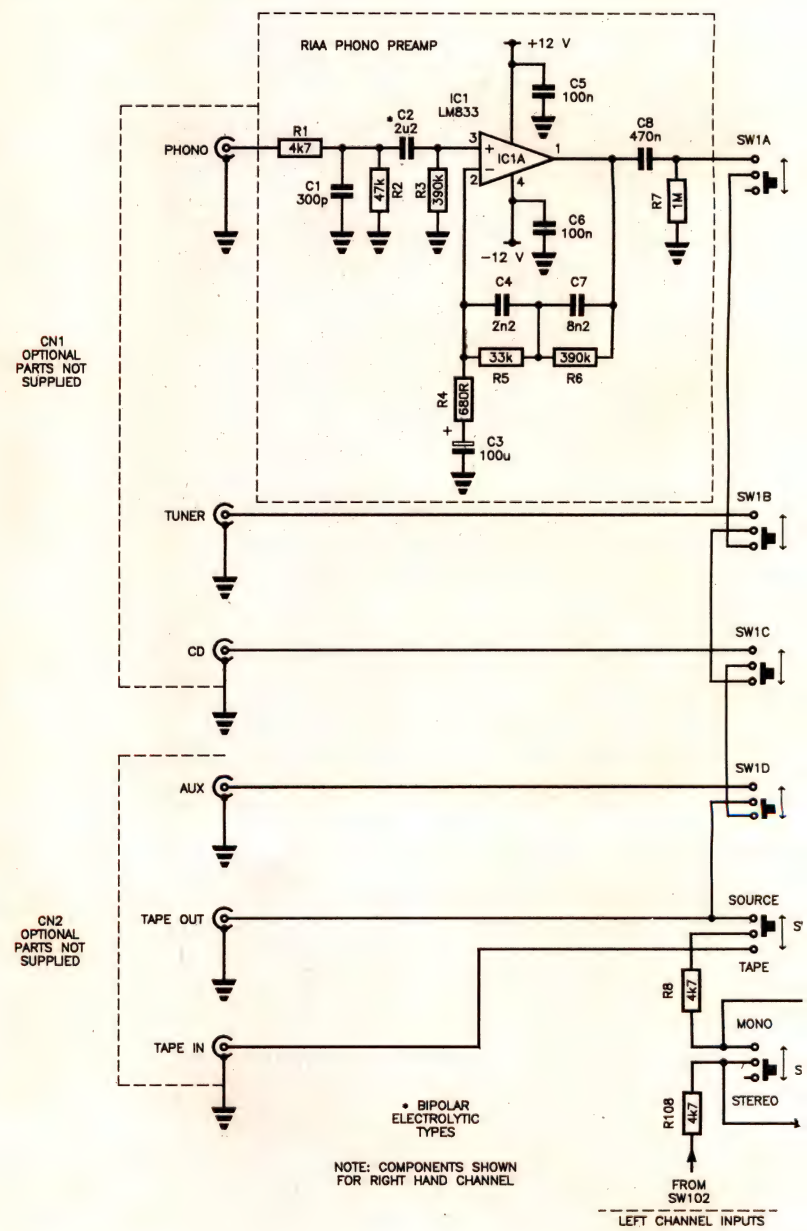
C). SW3 gives mono operation by connecting left and right inputs simultaneously to both amplifiers.

Resistors R8/R108 provide source isolation between left and right inputs and audio mixing of left and right inputs when mono operation is selected.

Now let us take the amplifier circuits. IC1 and associated components form an RIAA phono preamp. IC2 is a non-inverting amplifier with a gain of 6.5. IC3 and surrounding components form the tone control circuit. IC4/104 are the headphone amplifier ICs. These have an internally fixed gain of 20 so R17 and R18 are needed to attenuate the input.

You can buy optional components to build an on-board supply, as detailed in the text. Here, a 12-0-12 volt pc-mount stepdown transformer is rectified by diodes D1-D4, smoothed by C24 and C25, to produce positive and negative unregulated rails of about 17 V. Two three-terminal regulators, IC5 and IC6, then provide regulated ±12 V rails. If you get your dc for the three-terminal regulators from the power amplifier, it should range within 15 to 30 V. The required negative supply current is around 15 mA, and positive supply current around 70 mA, with the preamp running at the rated output of around 1 V RMS into 10 kΩ, and with 15 Ω headphones in use.

CIRCUIT DIAGRAM of the project.



0.002%), low input noise, wide bandwidth, high slew rate and wide dynamic range. It is ideally suited to the demands of today's digital recordings. A data sheet is reproduced elsewhere in this issue.

The tone control/line output stage employs a TL072, a high performance FET-input dual op-amp. Baxandall-type tone control circuitry is used.

To provide headphone output, an LM386 1 W audio power amp has been used, one for each channel. This should provide adequate level for both high impedance and low impedance headphones.

Split supply rails of ±12 V are used, derived from positive and negative three-terminal regulators (IC5 and IC6, respectively).

You can build the preamp as a stand-alone unit as provision has been made for an on-board power supply, or it may be powered from external dc supply rails of between 15 and 30 volts, such as might be used for your power amp modules. A pc-mount stepdown transformer is specified for the on-board power supply.

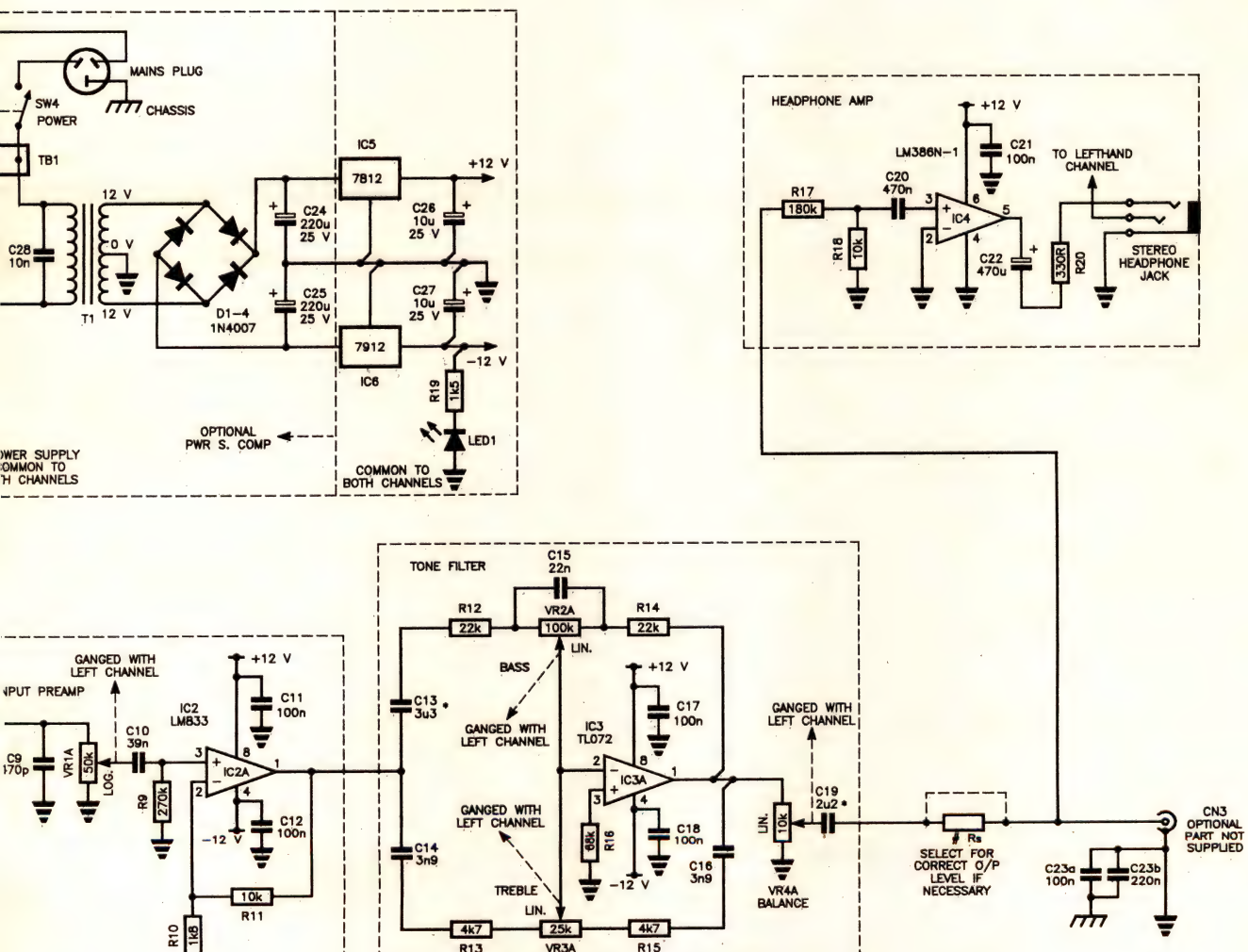
The printed circuit board has been designed to minimise off-board wiring, so that only the headphone socket and dc supply lines or mains input wiring to the board is required. Pushbutton selection switches that mount directly on the board have been used; likewise, the tone, balance and volume control potentiometers are mounted on-board. The input and output connections may be hard-wired, but note there is provision for a pc-mount RCA socket set for the input (this is optional).

Note that, with some of the capacitors, the pc board has been laid out with extra pads and holes so that either radial lead (vertical mounting) or axial lead (horizontal mounting) types may be used.

The placement of the switches and potentiometers has been arranged so that the front panel of the *Economy Stereo Amp*, K-4001 (AEM, August 1986), may be used as a front panel for this project. Indeed, that project's case (cat. no. H-2900)may also be used to house the project if you're building it as a stand-alone preamp in a 'component' stereo system.

Construction

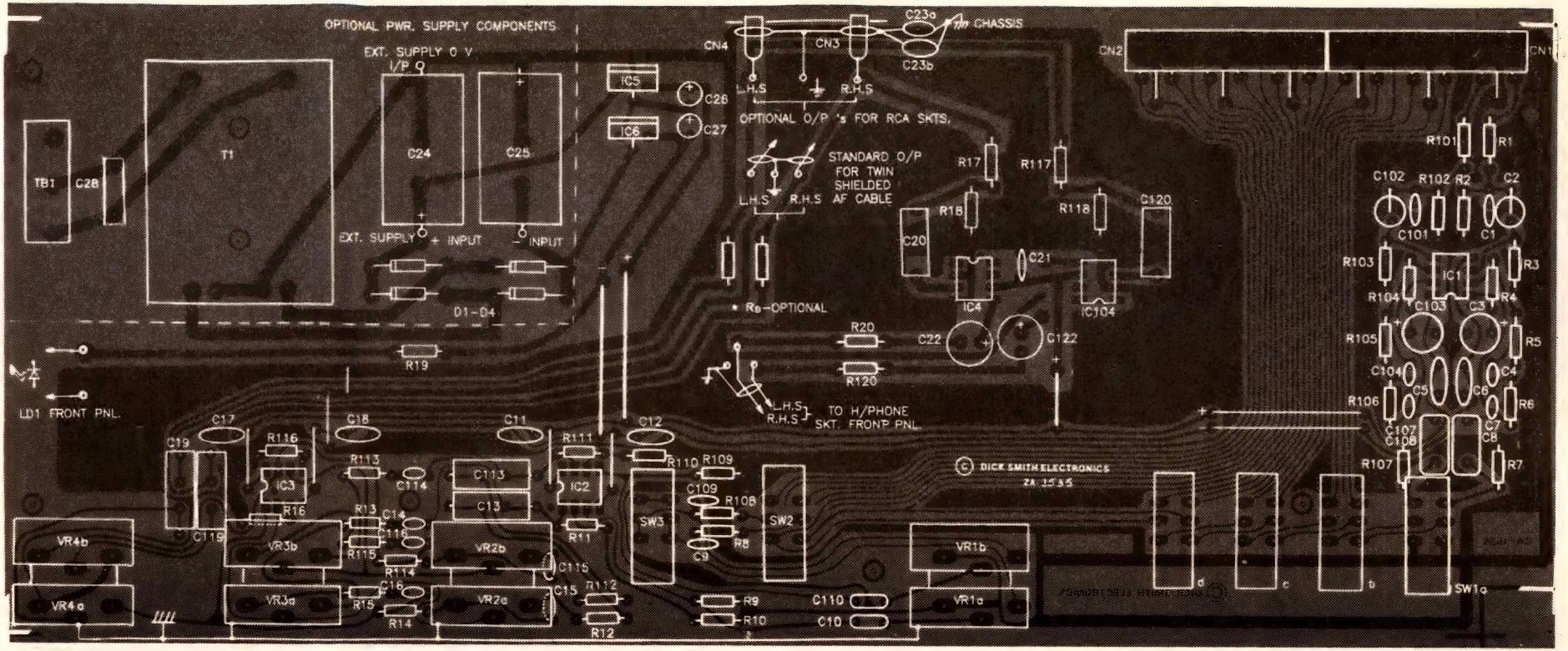
Right. Let's get on with the assembly details. First, the 'basic' project, as if you're building it into an existing amplifier which ▷



SWITCHING

SW1a - Disc (record player)
SW1b - Tuner
SW1c - CD (compact disc player)
SW1d - Auxiliary (tape recorder, etc)
SW2 - Source/Tape Monitoring
SW3 - Stereo/Mono Switch

All the input switches (SW1a/b/c/d) are shown de-selected (all pushbuttons out).



STEREO PREAMP PARTS LIST

Components listed for left hand channel only. Duplicate each component for the right hand channel, except those denoted by a #. Right hand channel components designated R101, C101, etc.

Semiconductors

IC1, IC2 ..... LM833
IC3 ..... TL072
IC4 ..... LM386
IC5# 7812
IC6# 7912
D1-4# 1N4007
LED1# ..... 3 mm red LED

Resistors all 1/4 W, 5% (unless otherwise stated)

R1, 8, 13, 15 ..... 4k7
R2 ..... 47k
R3 ..... 390k
R4 ..... 680k
R5 ..... 33k
R6 ..... 39k
R7 ..... 1M
R9 ..... 270k
R10 ..... 1k8
R11, 18 ..... 10k
R12, 14 ..... 22k
R16 ..... 68k
R17 ..... 180k
R19# 1k5
R20 ..... 330R, 1/2 W
RS ..... see text
VR1# . 50k log. ganged pc-mount
VR2# ..... 100k lin. ganged pc-mount
VR3# .. 25k lin. ganged pc-mount
VR4# .. 10k lin. ganged pc-mount half-track balance pot

Capacitors

C1 ..... 330p ceramic
C2 ..... 2µ2/40 V bipolar
C3 ..... 100µ/16 V RB electro.
C4 ..... 22n (.0022µ) greencap
C5, 6, 11, 12, 17, 18, 21, 23A ..... 100n (0.1µ) ceramic
C7 ..... 8n2 (.0082µ) greencap
C8, 20 ..... 470n (0.47µ) greencap
C9 ..... 470p ceramic
C10 ..... 39n (.039µ) greencap
C13 ..... 3µ3/40 V bipolar
C14, 16 ..... 3n9 (.0039µ) greencap
C15 ..... 22n (.022µ) greencap
C19 ..... 2µ2/40 V bipolar
C22 ..... 470µ/16 V RB electro
C23a/b ..... 220n (0.22µ) ceramic
C24, 25# ... 220µ/25 V RB electro
C26, 27# ..... 10µ/25 V RB electro
C28 ..... 10n/630 V polyester

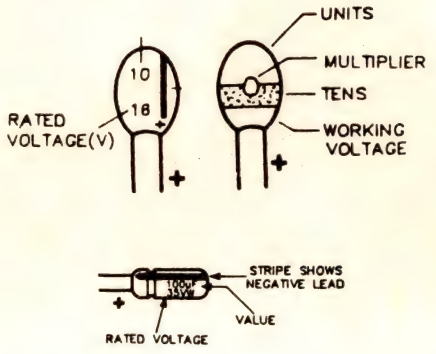
Miscellaneous

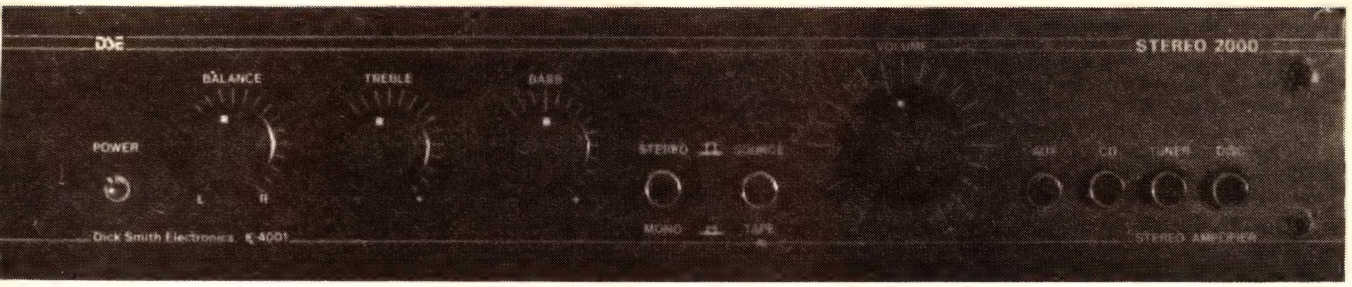
SW1 ..... 4-bank DPST P/B switch
SW2 ..... 1-bank DPST P/B switch (interlocking types)
SW3 ..... 1-bank DPST P/B switch
SW4 ..... DPDT mini mains switch (one only of each)
CN1, CN2 ..... 6-way RCA skts

K3045 pc board; T1, pc-mount power transformer (if required; 3-way pc-mount mains termination block (if required); heatshrink tubing, 3.0 mm x 80 mm; lug for mains cable earth with screw, nut and lock washer (if required); fitted mains cable, cord clamp grommet 5.0 mm (if required); 6.5 mm stereo headphone socket; 100 mm twin shielded AF cable; 500 mm tinned copper wire, 20 B&S; mounting hardware, knobs, panel, housing, etc — to suit individual circumstances.

Kit cost: $89.95

Component overlay diagram, showing placement of all the components and the on-board wire links. Note that one is not shown here — it runs from a pad adjacent to the positive lead of C122, to a pad adjacent to C21.





The preamp has been designed so that the front panel of the K-4001 Economy Stereo Amp (AEM, Aug. '87) may be used with it.

lso provides the power supply.

Even though you may be a relative novice at project construction, you will find this kit straightforward and unlikely to e too hard: provided always, of course, you consider what you re doing before you do it, and check connections and compon-nts again and again.

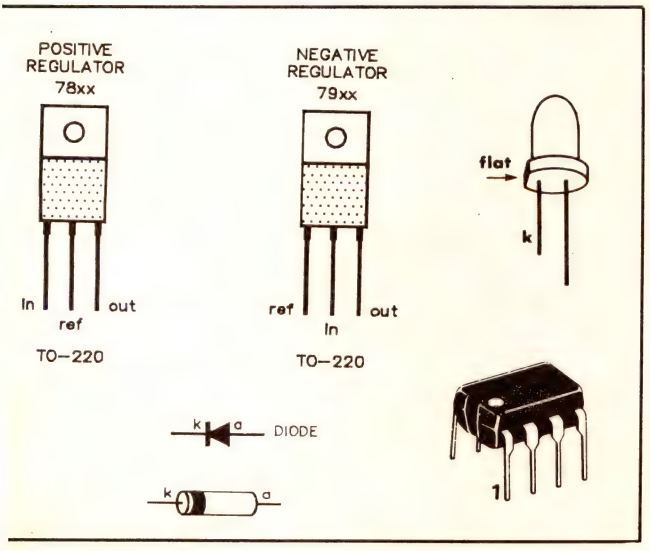
It is always a good idea before commencing assembly, to do a isual check of the pc board. See that all the holes are drilled nd of the correct diameter, although it's rare to find problems ere. Nevertheless, it can save hassles later.

The component layout diagram shows the where you put all components. It would be best to start by inserting the twelve inks. These are short lengths of tinned copper wire. Then follow with the resistors and capacitors. You can mount them in ny order. You will probably find it easier to mount the switch-s and potentiometers after soldering all the resistors and ca-pacitors in place as these are bulky components and would make the fitting of some components a little difficult. Be sure ou seat the pots and switches firmly down on the board before oldering. Note that the cases of the potentiometers are all inked together with a length of tinned copper wire which is hen linked to the board's earth plane at a hole behind VR4.

Solder all the semiconductors in place last. Take care when ou bend any component leads so that you don't break them ff. Be sure you get the orientation of all the electrolytic capaci-ors and semiconductors correct or you're likely to destroy omething when the project is first powered-up.

Fitting the module to an existing power amplifier is up to our imagination and any mechanical limitations of your power mplifier chassis.

When you are working out how you will go about fitting the wo together, you must think of the power supply, line output evel, and proximity of the amplifier inputs to the control unit c board. Refer to the power supply and output interfacing aragraphs later for details about interfacing the preamp with an existing amplifier. Mount the input sockets as close to the control unit pc board as possible to cut out unwanted pickup. Use shielded cable if necessary.



Stand-alone

When mounting the project in a case, the board may be supported at six places using standoff pillars. If you're using the H-2900 case, six drilled and tapped 15 mm-long standoffs are required. Two extra holes, of 3.5 mm diameter, for the board supports at the left hand end are required. Use the *unassembled* pc board as a template to mark where you will drill them.

The front panel will need a hole drilled in it for the headphone socket. Locate this hole above the stereo/tape switches located between the bass and volume controls.

Build the pc board as described for the basic project instructions, mounting the optional pc board components TB1, C28, T1, D1-D4, C24, C25, CN1, and CN2.

Fitting the pc board to the H-2900 case should be self-evident. You line up the 15 mm spacer holes with the bottom case holes. Note that you have to fit the pc board before you try to secure the front panel.

Draw the pc board through the case's chassis front aperture, then push it backwards to make it easier to fit the RCA input sockets CN1 and CN2. Secure these input sockets to the case with two No. 4 × 6 mm PK screws. Secure the front panel with four black M3 countersunk screws, nuts and washers. Now wire the headphone socket using twin shielded cable. You'll have to determine tip, ring and sleeve connections by inspection. The tip goes to the left channel output, the ring to the right channel and the sleeve to the earth (or common) via the cable's braid.

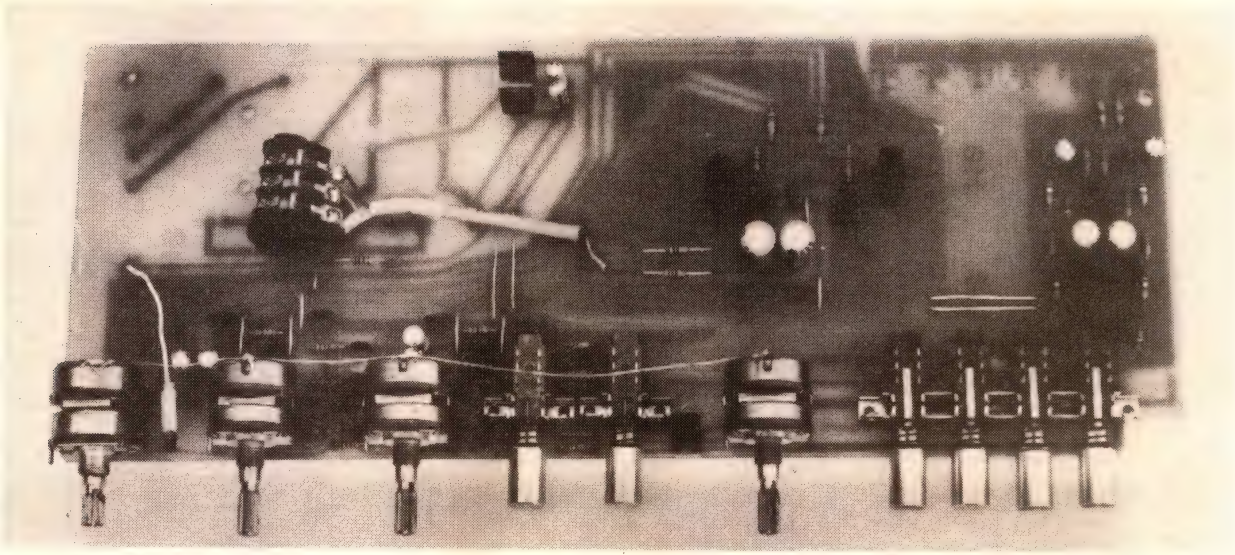
For the output sockets (CN3, CN4), use a stereo RCA socket set (e.g: cat. no. P-1442), or two panel-mount sockets, mounted to the case rear panel. You must make sure the metal outer of the RCA sockets is electrically isolated from the chassis. Refer to the component overlay diagram for the wiring details. Solder their earth tabs together.

Install the line output sockets after the main pc board. Mount the panel inside the case, securing it with screws and nuts. Run tinned copper wire from the pc board to the relevant output socket, for both the 'active' and the earth connections. Wires should be connected to both RCA earth tabs. Connect the two capacitors C23a/C23b between the chassis and the RCA earth tabs using a metal solder lug under an adjacent mounting nut.

The tinned copper wire running between all the pot cases should be run, not to the pc board earth, but to a solder lug under one of the chassis-front panel screws.

The power switch, SW4, mounts on the far left side of the front panel. The mains cable is secured with a clamp grommet, a hole for which is provided in the rear apron of the chassis. Route the mains cable active (BRN) and neutral (BLU) wires directly to the power switch and the switched output directly to the terminal block, TB1, on the pc board. Note that the incoming mains leads go to one set of the switch's contacts, *NOT* the pole connections, so that the switch does not make the unused contacts live when switched off.

Attach the mains cable earth lead to the chassis using a solder ▷



Top down view of the preamp, assembled in its 'basic' version without the optional components.

lug, nut, screw and a shakeproof washer. This lead *must* be longer than the others so that it's the last to break in the event of an accident that wrenches the leads free.

Note also that you must sleeve all the exposed mains switch connections with heatshrink tubing in the interests of safety. Safety, in this instance, means your life and the life of anyone who works on the unit, so you have a responsibility to play it safe. Additionally, cover the front panel LED's exposed connections with tubing.

First tests

Do a *thorough* visual check of your work and correct any errors. Organise an audio source, headphones and an amplifier, and a dual-rail power supply if the unit's not stand-alone. You'll need a multimeter for dc checks.

Apply power and check the two supply rails with regard to earth. The two long links behind SW3 (refer to the component overlay diagram) are the best place to do this. If you find no supply here, switch off the power and check that IC5 and IC6 are the right way round, or if you're using the on-board power supply, check for correct orientation of diodes D1-D4.

If, or when, your first check goes OK, then check at the supply rail pins of all the op-amps. If you have any problems here, it's likely to be a dry joint. With the power off, carefully trace and re-solder all the joints in the affected track.

Once all the dc checks are out of the way, plug in an audio source — tape, CD or record player — and prepare to check the output on the headphones. For this test, you should first set the volume control fully off, the balance and tone controls at centre position, the mono/stereo and tape/source switches both out, and the appropriate source switch pushed in.

Power up, set your source going and then advance the volume control. You should hear the source clearly in the headphones. If you have any problems here, check that you have the source correctly plugged in and set up, and that the headphone socket is correctly wired.

If, or when, all's well, play with the balance and tone controls, mono/stereo switch etc, to see that everything functions as expected. Now you're ready for a full try-out. Good luck and good listening!

Output interfacing

The stereo control unit as specified is designed to work into a power amplifier input resistance of about 10 kΩ or higher. The output level into this load is 0.8 V RMS for a 150 mV RMS input.

If you need to, you can lower the output level by wiring in the optional series resistors (Rs) and cutting the tracks between the pads. Refer to the component overlay diagram to find wher they are located.

The value of the series resistor is calculated according to th formula:

$Rs = Rpa\,(1 - x)/x$

where $x = Ed/Eo$,

Ed = max. desired drive voltage

Eo = max. output voltage of control unit

Rpa = power amp input resistance

Rs = series resistor value

NOTE: this is only valid where the value of Rpa is $\geqslant 600\ \Omega$.

For example, if a drive level of 0.5 V RMS is needed for a powe amplifier having an input resistance of 10 kΩ;

$Rs = 10{,}000\,(1 - 0.625)/0.625$

Because $x = 0.5/0.8$

Thus, $Rs = 6k$

So, select the nearest preferred value for Rs. i.e: 5k6.

You may have to increase the value of R18/R118 in the head phone amplifiers if the output level is decreased. However, a there is plenty of level into the amplifiers you should find it ur necessary to change these.

For power amplifier input resistances of less than 7 kΩ, yo will have to increase the value of the coupling capacitor C19/C119 to preserve the low frequency rolloff of 10 Hz.

The new value for these can be calculated from:

$C = 1/2\pi FcRL$, where

Fc = 10H z

RL = Rs + Rpa

Rs = series resistor, if used, and

Rpa = power amp input resistance

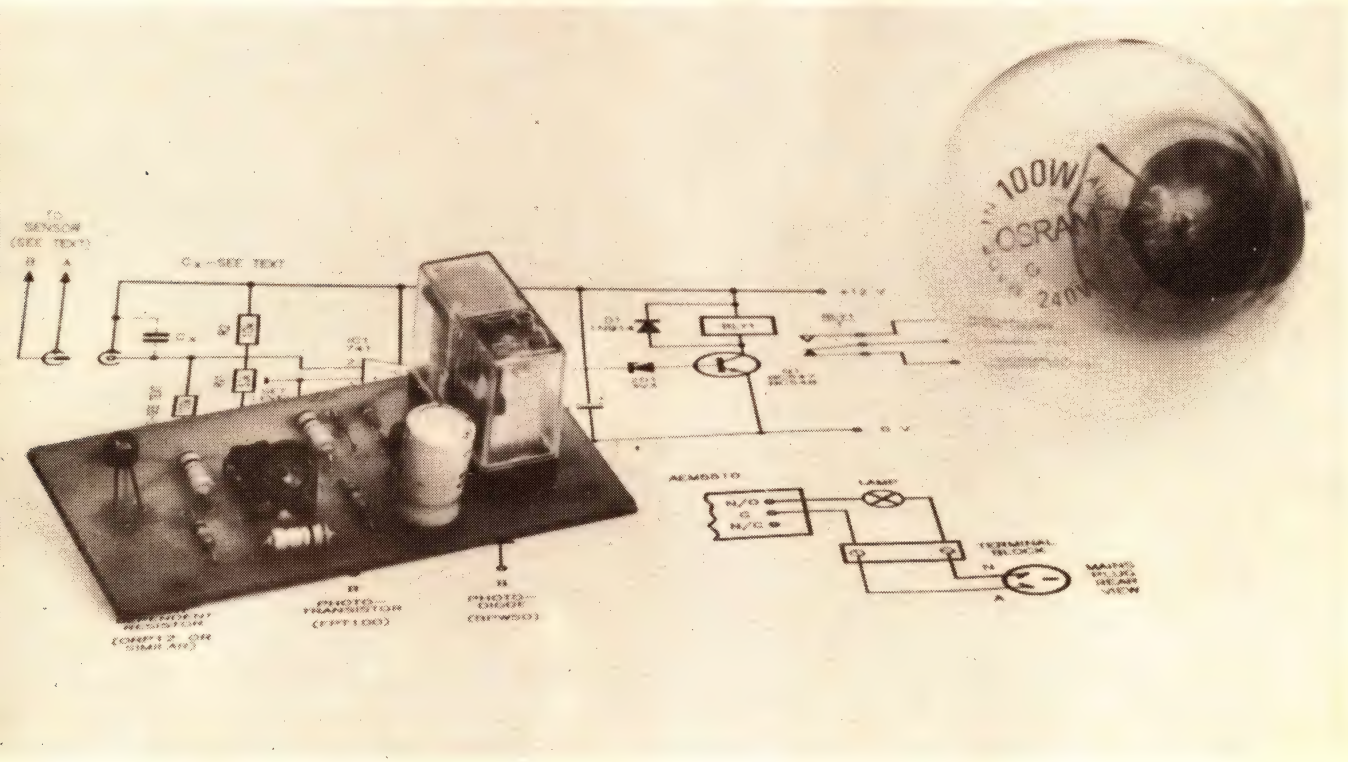
e.g: for a given power amplifier the drive level is correct b with an input resistance of 5 kΩ:

$C = 1/6.2810 \times 5000$

$= 3.2\ \mu F$

use the nearest preferred value, 3.3 µF.

This month's Star Project is from Dick Smith Electronics who will be marketing kits through their stores and dealers; cat. no K-3045, $89.95 for the basic kit. Mail order enquiries to PO Bo 321, North Ryde 2113 NSW. (02)888 3200.



The 'night-n-day' relay

Roger Harrison

This project controls the switching of a relay according to the available light level falling on a light-sensitive detector. It may be used to switch on a porch light, or other outside light, when night falls or control the daily switching on and off of a fish tank light, for example. Doubtless resourceful constructors will find plenty of uses!

HAVE YOU EVER fumbled at the front door with your keys on a dark night? Or left the fish tank light on all night so often you forget how many times you've been reminded about it? Undoubtedly these little hassles in life could be fixed with one of those electromechanical time switch gadgets; but then the long days in summer and the long nights in winter necessitate your remembering to reset them every few months and that's even harder and more hazardous than trying to remember something every day!

They're pretty straightforward, everyday applications. Let us illustrate with one that's a little unusual. The entrance to our first floor offices here at the magazine is on the western side of the building. There is a short hallway leading to the bottom of the stairs to the first floor. Early in the morning and in the late afternoon, that short hallway is mighty dark, despite there being plenty of light outside.

Inevitably, because it's quite light upstairs, the light for that hallway doesn't get switched on until well into the evening when switching on other lights reminds you; or in the early mornings, it's rarely switched on at all. At such times, negotiating that first step of the stairs, going up or coming down, can be hazardous.

LEVEL: We rate this construction project as suitable for constructors of:

INTERMEDIATE

experience, between beginners and experienced constructors, with experience in building a number of projects of differing complexity.

Why couldn't we have an *automatic night and day* switch for the hall light, we were asked? Well, this project is ideal for the application. In fact, it's ideal in any application where you can detect changes in light level and use that to operate something via a relay.

Sensors of light

A variety of different electronic devices are available which can 'sense' the presence of light. They are generally termed *photosensors*, and they are all semiconductors of one sort or another. What all these devices do, in brief, is alter some characteristic in response to changes in light falling upon their active surface. ▷

There are three common types of photosensor commonly available through electronics retailers. First, there's the *photoconductive cell*, otherwise known as a *light dependent resistor*, or LDR; secondly, there's the *photodiode* and lastly, there's the *phototransistor*.

Light striking the surface of a conductive material can provide sufficient energy to cause electrons in the material to leave the atoms to which they're normally attached. These extra free electrons are available to add to the existing free electrons always present in conductive material and thus the material's resistance *decreases* in response to the increased energy provided by the light energy falling on the material.

This property is exploited in LDRs, which consist of a thin layer of cadmium sulfide (CdS), or less commonly — cadmium selenide (CdSe), on a disc-shaped base with metal terminations deposited across it having "fingers" running between each other. Terminal leads are then attached to these. This assembly is then encapsulated in a flat cylindrical casing with a "window" allowing light onto the active surface. The terminal leads may project from the rear, for 'face up' mounting, or from the side for vertical mounting.

The accompanying picture shows a common LDR, the ORP12. It can be bought for about $1 to $2, or so. This device has a response that is most sensitive to visible light with wavelengths between 500 and 800 nanometres (nm).

Light falling on the junction of a semiconductor diode will bring about an *increase* in its reverse leakage current. When a diode is reverse biased, always a small *leakage current* will flow. Thermal energy — heat — generates hole-electron pairs

An ORP12 LDR. The 'active' surface is seen through the window on the top. Typically, it will have a dark resistance of around 10 MΩ. At a light level of 50 lux, its resistance typically drops to around 2500 Ω; less than 150 Ω with a light level of 1000 lux. Dick Smith Electronics stock a device with similar characteristics known as the DSCD01.

(remember how semiconductors work?) which move across th junction, and this accounts for the reverse leakage curren hence, increasing the diode's temperature will increase the re verse leakage current. Light falling on the diode's junction wi *also* generate hole-electron pairs, increasing the reverse leak age current. The more light is concentrated on the junction, th greater the increase in reverse leakage current.

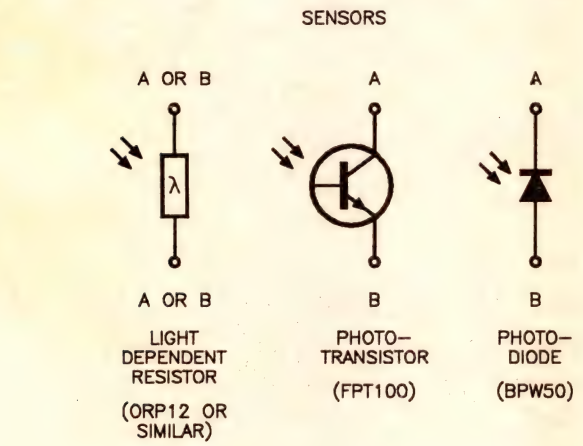
Photodiodes come in a wide variety of packages and charac teristics. Some have an integral lens, others do not. Some re spond to visible light, others respond to infra-red. With no ligh falling on the junction, the diode's 'natural' reverse leakage cu rent dominates; this is known as the dark current. A quite com mon photodiode is the BPW50. This has a response that peak in the infra-red region, centred on 900 nm but is still quite sens tive at visible light wavelengths. The BPW50 can be bought fo around $2.50 to $3.50.

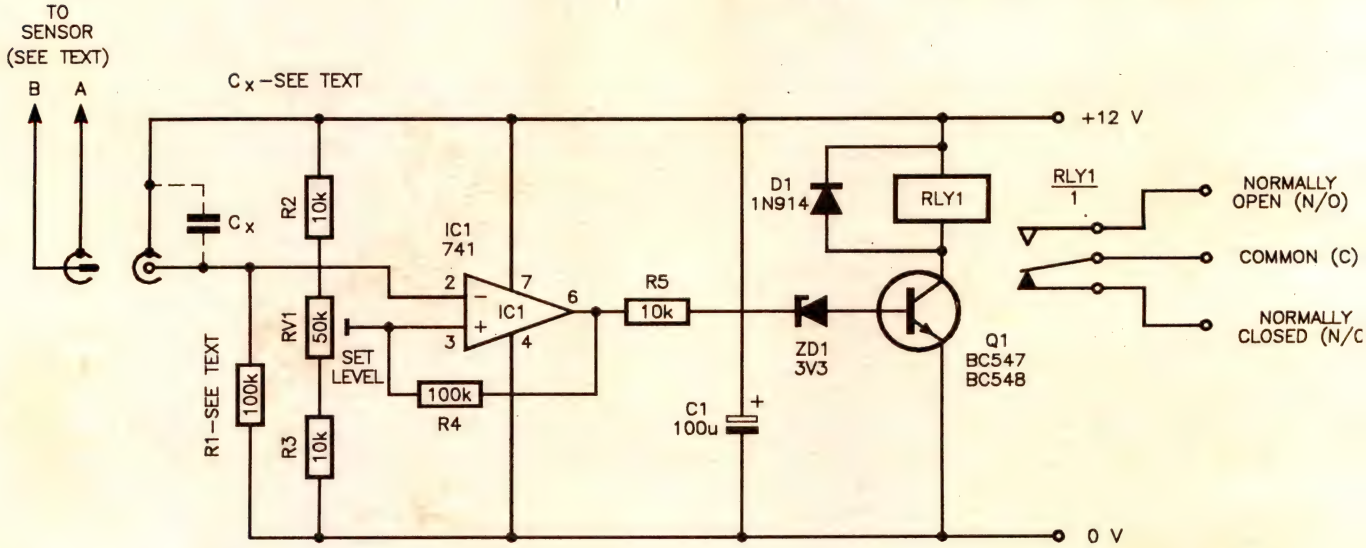
A phototransistor is constructed with an enlarged collecto base junction which works in the same manner as a revers biased photodiode controlling the transistor's collector curren Light radiation falling on the collector-base junction *increase* the collector-base leakage, this *apparent* base current is the amplified by the transistor in the usual way, greatly increasin the collector current according to the current gain of the transi tor.

With no light falling on the c-b junction, the collector's leak age current (thermally induced, as in the diode) is called the co lector dark current. The FPT100 is a very common phototransis tor with a response in the visible light region. It has a small len in the top of the package to focus the light onto the device's en larged c-b junction. The FPT100 has three "legs" connected t its base, emitter and collector, but other types of phototransisto may only have two legs, providing connection to the emitte and collector only. The FPT100 costs between $1 and $2.

To summarise:

- With an LDR, the *resistance decreases with increasing light.*
- With a photodiode, the *reverse current increases with increas ing light;* and,
- with a phototransistor, the *collector current increases with in creasing light.*





Any of these devices may be successfully used in this project, but some adjustment to component values is necessary, as detailed later.

The circuit

The circuit is simplicity itself. An operational amplifier (op-amp), IC1, 'senses' the characteristic change in the photosensitive device and is arranged so that its output swings to the positive rail when the light level falls below a certain threshold, or to 0 V if it rises above a given threshold. That is, it's arranged here to act as a switch. The op-amp's output drives the base of a transistor, the collector current of which flows through the coil of a relay. When the base gets current, which happens when the op-amp's output swings positive in response to the light level falling, the relay is operated, its contacts switching the circuit of whatever you wish to control — in our case, a lamp.

The photosensitive device connects across the points marked A and B, which places it in series with R1. An LDR is not polarised and may be connected either way round, its light controlled resistance varying the current flowing through it and R1. A photodiode and transistor are polarised so that the photodiode will be reverse biased when connected as indicated, its light-controlled leakage current flowing through R1, while the emitter-collector junction of a phototransistor will be forward biased, its light-controlled collector current flowing through R1.

The photosensitive device and the resistor R1 form a voltage divider. The junction of R1 and the sensor is connected to the inverting input (pin 2) of the op-amp, IC1 (a 741). With light impinging on the photosensitive device, it will conduct more current and the voltage at this junction will tend towards the positive supply rail. When the light level falls, the current through the photosensitive device decreases and the voltage on the op-amp's inverting input will fall towards the 0 V rail.

The voltage on the non-inverting input of IC1 (pin 3) is preset by a "trimming" potentiometer (or "trimpot"), RV1. When the voltage on pin 2 of IC1 (the inverting input) falls below this pre-set level the op-amp output (pin 6) swings toward the positive supply rail, driving current into the base of Q1 and operating the relay.

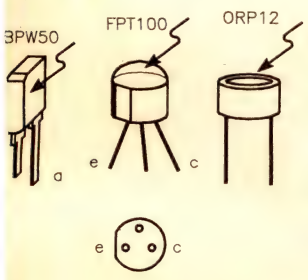
Whenever the light intensity rises, the voltage on pin 2 of IC1 will increase because with an LDR its resistance decreases, increasing the current through it and R1 and the voltage across R1 will rise, or with a photodiode or phototransistor, the current through them rises, with the same result. The voltage across R1, and thus the voltage on pin 2 of IC1, will increase until it is higher than the voltage on pin 3, determined by RV1, and the op-amp's output will swing to zero volts. Transistor Q1 then receives no base current and the relay turns off.

To avoid the lights flashing on and off around the switching level with small fluctuations of light, *hysteresis* is provided by R4. It works like this. When the output of IC1 is low (0 V) the current through R4 reduces the pre-set voltage level on pin 2. When the output of IC1 switches high (towards the positive rail), the voltage on pin 2 is increased by the current through R4. The effect is to switch the lights on at one light level and off at another light level, thus avoiding any tendency to oscillation.

The zener diode prevents the transistor, Q1, from being permanently turned on as the output of the op-amp cannot completely reach the 0 V rail. The op-amp's output must reach about 4 V before the relay operates (determined by the 3.3 volt zener voltage plus the 0.7 V base-emitter voltage of Q1).

The photosensitive device may be mounted on the project's printed circuit board, or remote from it. If mounted remotely, hum picked up from mains wiring may cause problems. The function of the capacitor Cx, dotted-in on the circuit diagram across the A-B input connections, is to reduce its effect. A value between 10n (0.01µ) and 470n (0.47µ) should do the job.

The unit is powered from a (nominal) 12 Vdc supply which may be derived from any handy source, such as a plugpack. The project draws less than 100 mA at most. Supply bypassing is provided by C1, and D1 shorts out the reverse-voltage back EMF from the relay coil when Q1 switches off.



Photosensor pinouts. The FPT100 and BPW50 require correct orientation. With the FPT100, the emitter (e) goes to input B on the board, the collector (c) to A. With the BPW50, the cathode (k) goes to input B, the anode to A. An LDR may be connected any way round.

Construction

The project is constructed on a printed circuit (pc) board with the relay contact connections well away from the other circuitry for safety when switching the 240 Vac mains. The photosensitive device is located at the other end of the board and the board may be orientated so that whatever device you use can be faced towards the light.

Alternatively, the photosensitive device may be mounted at a convenient place away from where the pc board is located. It may be connected by a suitable plug and socket arrangement, but a shielded cable should be used to reduce hum pickup.

So, one of the first things to do is to determine where you're going to locate the project and/or the photosensitive device. This will determine a few things regarding the project's construction — and the parts required. You may want to mount the pc board in a small plastic enclosure, providing a small hole for light to fall on the photosensitive device mounted on the pc board. Or, mount the pc board behind a wall panel, in a small box or not, as required. As different circumstances differ widely, we've necessarily left these details to you. However, for long term reliability, ensure that dust is kept off the pc board.

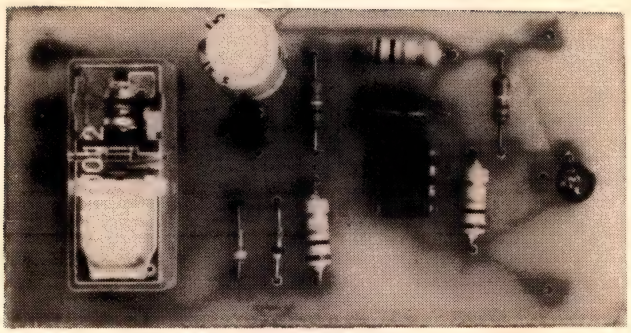
Assembling the components to the printed circuit board is quite straightforward. The component overlay diagram here shows the placement of all the components. First, however, give the pc board a visual check — no matter whether you've made your own or bought one. Check for small copper "bridges" between closely-spaced tracks or pads. See that all the holes are drilled and of the right diameter — drill them out if they aren't. See that the pins of the relay fit through the holes for them. You may need or want to drill holes for mounting bolts on the four corners.

Leave the relay till last as it's a relatively bulky, heavy item. Solder the resistors in place first. While they aren't polarised and don't have to be placed in a particular orientation, it's a good idea to orientate them with their colour code bands all facing in the same direction. This aids checking and makes for a neat assembly. The trimpot, RV1, is a miniature, vertical-mounting type and its pins will only fit one way in the three holes provided.

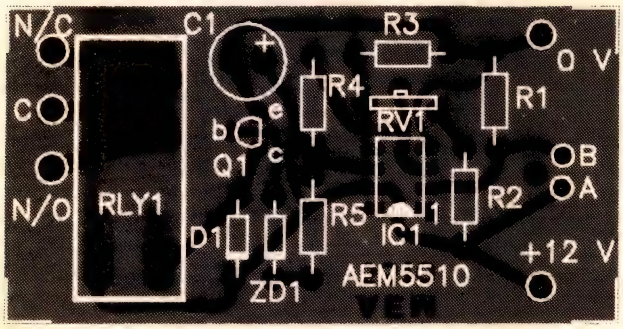
Note that the value of R1 will depend on what photosensitive device you are using. If you use a phototransistor as we have done, you will find the value of R1 correct at 100k. However, if you use a photodiode or an LDR, you may have to increase the value of R1 to 1M so that the op-amp is able to switch properly at low light levels.

The hysteresis, or difference in light levels between turn-on and turn-off, is set by the value of R4 and is designed to avoid oscillation around the switching point caused by small fluctuations of light. Increasing the value of R4 decreases the hysteresis and vice versa. We found 100k a good value.

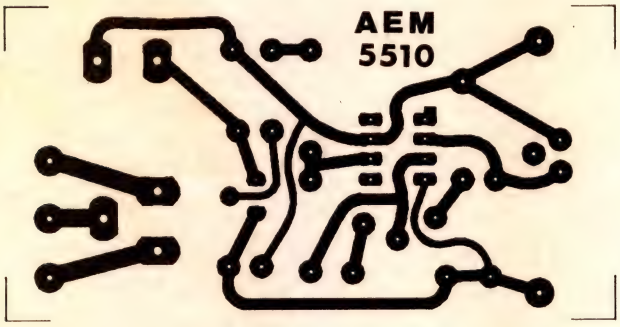
With the resistors in place, next install the zener diode, the diode, the 741 IC and the transistor, *taking care to place them all the right way round.* Consult the component overlay diagram. The diodes will have a band at one end (marking the cathode), ▷



View of the completed pc board, with an FPT100 phototransistor installed (at the end opposite the relay).



Component overlay. Note the orientation of the semiconductors and the electrolytic capacitor, C1.



Full size reproduction of the printed circuit artwork.

and these should be placed to correspond with the band shown on the diodes on the overlay. IC1 will have a notch or prominent indentation in the top at one end and this corresponds to the mark shown on the overlay. Or perhaps it will have a small indentation adjacent to a pin at one corner — this is pin 1. The transistor orientation can be determined from the pinout, relating this to the overlay. With the semiconductors in place, then solder capacitor C1 in place, making sure you get it, too, the right way round.

If you're mounting the photosensitive device on the pc board, do it now, keeping in mind where you're going to locate the project so that you can orientate it correctly, allowing the light to fall on it.

Note that the board has been designed so that an FPT100 phototransistor will mount directly to it, the collector going to A, emitter to B. This faces the sensitive area of the device upwards from the top surface of the board. The BPW50 will also mount on-board, cathode (the shorter leg, marked 'k' on the pinout diagram) to A. This places the sensitive face at right angles to the board, facing away from the relay.

If you're using an LDR, you'll find the leads a bit widely spaced for mounting directly to the pc board. To mount it on the board, you'll need to carefully bend a "dog's leg" in one or both

AEM5510 PARTS LIST

Semiconductors

D1 ..... 1N914
IC1 ..... LM741, uA741 etc
Q1 ..... BC458
ZD1 ..... 3V3 zener

Resistors all ½ W, 5%

R1 ..... 100k (see text)
R2, R3 ..... 10k
R4 ..... 100k
R5 ..... 10k
RV1 ..... 50k min. vert. trimpot

Capacitors

C1 ..... 100u/16 V RB electro.
Cx ..... (optional — see text)

Sensor

LDR — ORP12, (DSCD01) or similar; or Phototransistor — FPT100 or similar; or Photodiode — BPW50.

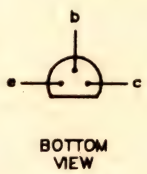
Miscellaneous

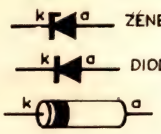
RL1 ..... SPDT pc mount relay with 12 V/180 Ohm coil, 240 Vac/5 A contacts.

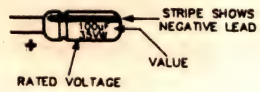
AEM5510 pc board (80 x 40 mm); RCA line plug (optional); RCA panel socket (optional); UB3 zippy box 41 x 68 x 130 mm (optional); 12 Vdc plugpack (if not on-hand); dc connector for plugpack.

Estimated cost: $14-$20 (depending on options)

See our 'PROJECT BUYERS GUIDE' this issue for a guide to component sources and kit suppliers.







leads using two small pointy-nose pliers so as not to stress th lead terminations in the device's package.

The relay is soldered in place last of all. See that the pins ar generously soldered, but not with big blobs on the pads.

With the board completed, you're ready to give the proje an initial test run. If you're not having the photosensor or board, just attach it with short lengths of light hookup wire fo the time being.

Checking it out

First, give the board a thorough visual check. See that all th solder joints are clean and shiny, not dull, "frosty" or rounde blobs — all of which indicate poor joints. Fix any that see dodgy right now. Check the orientation of the semiconducto and the electrolytic capacitor C1. When you're convinced all well, proceed.

Set the trimpot RV1 to mid-travel. Temporarily attach 12 Vdc power supply (making sure you get the polarity cc rect!). Switch on. The relay *may* temporarily switch on, then c again.

With the unit powered-up and light falling on th photosensor, the relay should be off. If, when you power-u the relay comes on and remains on, try adjusting R1 until clicks off. If any adjustment of R1 does not permit the relay click off, turn off the power supply, disconnect the board ar look for a fault. It's more likely to be a faulty joint (90 per ce of problems on first checkout!), or an incorrect resistor value, I or ZD1 placed the wrong way round.

With light falling on the photosensor and the relay off, cov the photosensor with a piece of cardboard or plastic to shie the light falling on it. The relay may click on, or it may not. If doesn't, with the photosensor still shielded, adjust RV1 until does click on. If any adjustment of RV1 under these circu stances does not result in the relay operating, turn off the su ply, disconnect the unit and look for a fault. Check joints *fir*

hen look for an incorrect component value, or semiconductor ie wrong way round.

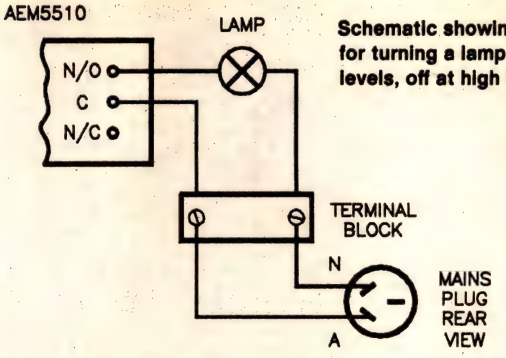
With the project operating, you should be able to get the re- y to click on and off simply by covering and uncovering the hotosensor.

nstallation and application tips

he unit, or at least the photosensor, should be installed such iat there is no possibility of the light from the lamp it controls f it's controlling a lamp) reaching the photosensitive device. If does, it will promptly turn itself off, then on again etc! Not uite the effect intended.

When installing the photosensor remote from the unit, see iat all leads are covered in "spaghetti" insulation and securely ped up or otherwise sealed, or cover them in heatshrink. Use polarised plug and socket to connect it to the board (unless ou're using an LDR), so that the sensor can't be plugged in the rong way round.

Wiring details for controlling a lamp are shown schematic- ly in the accompanying diagram. *Any* mains interconnections ust be done with standard line plugs and sockets, unless the oard is wired inside an existing fixture. Observe that the *active*



Schematic showing connections for turning a lamp on at low light levels, off at high light levels.

is switched using the relay's normally open (N/O) contacts. Cover, or otherwise protect, all the relay contact connections on the underside of the board to prevent accidental contact.

You will need to experiment with the setting of RV1; this is best done *without* mains hooked up to the relay connections, for safety's sake.

The project may be used equally well to turn something *off* as well as on. Just use the common (C) and normally closed (N/C) pair of relay contacts.

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avvy serviceman or unday solderer – you need this!

he 3M 8501 kit is designed for electrostatic protection static-sensitive components during field service ills. Static damage can occur anywhere microelec- onics are used, but they are particularly susceptible uring servicing. The kit comprises two 3M CHARGE- UARD 2200 Series wrist bands, a 56 x 61 cm flexible atic-dissipative work surface with two pockets, and a oiled cord system to attach the operator to the work irface and the work surface to a suitable ground. The ords contain built-in one megohm resistors to ensure perator safety.

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3) '3M' is a strange name for a company. What does it actually stand for?

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Just in case you lose yours - or want to give control to more than one person. **$9.95**

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With a Zener diode tester, of course. And now at this month's bargain price you can easily afford to have this valuable bit of test gear on your shelf. Exclusive to Dick Smith Electronics (as described in ETI), includes case and pre-punched front panel. Cat K-3051

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Microwave ovens: those marvels of the eighties, can also be downright dangerous. If yours leaks, it could cook you instead of the food! Check out the microwave with this smart leakage detector. No batteries to go flat, so it's virtually fail safe. Positive safe/unsafe test. Cat K-3095

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Lets you connect a modem to your VZ computer. Cat K-6317 **$19.95**

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Combines both colour organ and chaser one unit! Cat K-3143 **Now $**

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PLEASE NOTE: Stocks of many of these kits are becoming very low in some stores. If your local Dick Smith Electronics store do not have stock of the particular kit you require, they will endeavour to obtain it for you from another store.

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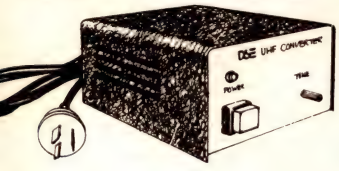

Own A DFM? Get More Range!

Digital frequency meter prescaler kit gives up to 500MHz range from your current (100MHz or so) meter. Simple construction, really worth its salt! $1 off our already low low price.
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Cat K-3450

ANOTHER $10 OFF: NOW ONLY $29.95

Ahh! So Soothing!

There've been some pretty extravagant claims made about negative ions. Even if only a small percentage are true, we believe a neg ion generator can be really beneficial. This one is completely safe because it doesn't use a mains multiplier (operates from a safe plug-pack adaptor); is easy to build and, well, you be the judge. You'll certainly judge the $5 saving to be tops! Cat K-3333

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Normally $59.95
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Transmitter: Cat K-3434 **Normally $169, Now $149**

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It was $99.95 in the 1988 catalogue. Now it's down to an incredible $59! The low cost amplifier makes a great "first" project - the short form kit is all one one PCB, includes all components, controls, etc but not a case or transformer (we figured most hobbyists would already have those!)
Cat K-4001

AMAZING $59

Nice Picture: Shame About The Sound!

Most video recorders do a pretty good job at handling the video signal but, oh, the sound! And when you record off a recording (who'd do that?) it's usually magnified. Fix up crook VCR sound with this processor: gives simulated stereo, 5 band equaliser allows tailoring the sound the way YOU want it, and noise filter virtually eliminates that zzzshj!
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Amplify The Savings!

Here's a twenty dollar saving off a hundred watt amplifier for one forty four megs! Now the translation: our 100W 2m linear amplifier kit was $279, this month all you'll pay is $259! Now get your hand-held up into the big league!
Cat K-6313

$259

It's Alarming

Burglary is again on the increase. Beat them before they beat you with this home alarm kit: you'll have a fully professional system which can be installed virtually anywhere (using commonly available detection sensors) and will scare the pants off the felon! Cat K-3424

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If It's Real Power You Want . . .

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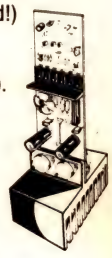

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Last Chance For Glass RTTY!

Stocks of the VZ300 have almost gone - and so have the RTTY decoder kits. This month (or until they're all gone!) save a big one third off the already drastically reduced price. We're clearing them out to make way for new kits - so you reap the benefit! Cat K-6318

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B641

Timely tips for tube tinkerers

This month we have some useful hints and tips for the restoration enthusiast or serious valve hobbyist, a couple of interesting readers' letters and a fascinating look at some kit instructions of yesteryear.

AMONG the many and varied faults encountered when restoring early valve equipment, we have picked out for this article a number which are commonly encountered.

Power supply problems rank top of the list. Faulty rectifiers are the top cause here, often accompanied by faulty electrolytic capacitors. If the power supply checks all right, then the next most frequent problem encountered is a leaky coupling capacitor between the plate of the detector or audio preamp and the grid of the output valve.

This can put a positive voltage on the output valve grid which is the opposite of what de Forest aimed to do when he invented the negatively-polarised grid. Positive volts on the grid make the valve draw excess current: there are no NPN and PNP variants of valves where some like positive volts on the grids and others insist on negative.

Bias on the output valve's grid should be several volts negative: relative to the cathode, that is. Different circuits achieved the negative grid bias in different ways. No volts on the grid might mean there are a few positive volts on the cathode: the grid is then negative with respect to the cathode and thus the positive cathode voltage supplies the effective negative bias for the grid.

Frying noises in the output audio are usually caused by a noisy plate resistor or preamp valve. Dielectric breakdown of a silver-mica bypass capacitor from plate to earth in these stages also contributes to the problem. This fault is a typical problem in the 1950s HMV *Little Nipper Series* radios.

It's a fairly safe policy to treat all capacitors as ready for the old age pension, and electrolytics as wizened with age. Retire them, and replace with modern ones. Just make sure that not only capacities are correct, but that voltages are high enough.

Resistors usually age better, but treat them with suspicion too. With the high value ones, a good hearty megger (*out* of circuit) separates the old men from the boys more effectively than a multimeter resistance check.

Aerial coil components may be faulty if a severe overload occurs when the antenna is connected. A possible cause is the grid resistors in the first stage going high or open circuit. Also, bypass capacitors in the plate or screen circuits could be leaky or have reduced capacity. Wild oscillations in the set are often caused by this problem.

If you're lucky enough to gain possession of a set which is in working order, probably the most evident of all problems is a reduced and/or distorted audio output. The most common fault causing this is the preamp stage's plate resistor going high or open circuit. Expect to find a value of 220 to 270 kΩ for normal operation.

Your set may be suffering from poor sensitivity. In this case it is wise to check, or recheck, the converter valve *AND ALSO* note if the alignment has drifted. Early sets frequently show poor tracking, usually at the bottom end. This can be cured in most cases by sliding a "shorted-turn", made of hook-up wire, around one end of the oscillator coil. However, this usually throws the sensitivity on the bottom end a bit low. This is fixed by using the same remedy on the other front end coils.

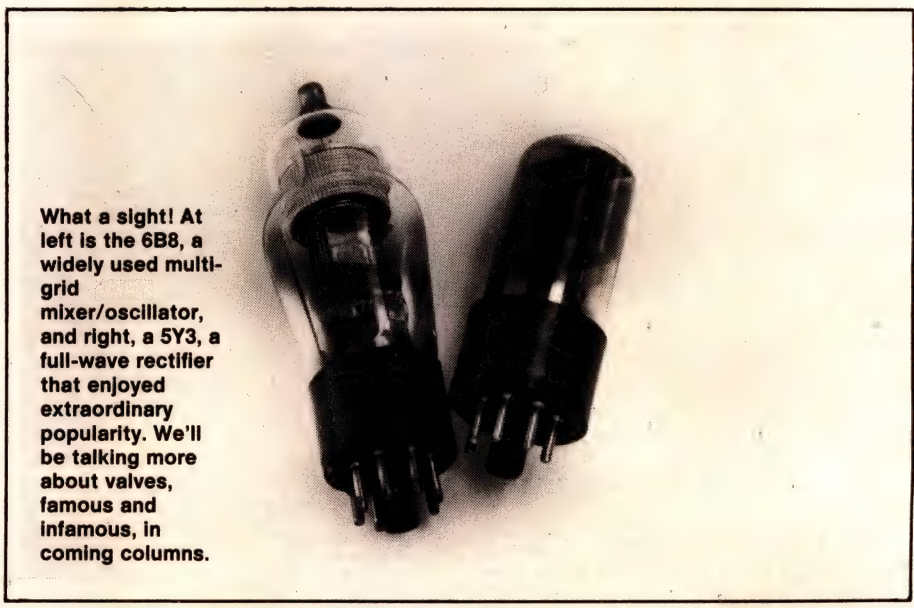
To make an old superhet talk nicely we advise replacing the converter and IF valves and accurately align all RF stages.

Reflex receivers also develop many of the faults already listed. Further problems can also develop with these receivers in the high gain stages which are prone to oscillate. Reflex are often "deaf" in weaker signal areas.

Whistles in your set may also be a problem. In such cases, check all valve shield earthings. The low IF frequency was often the source of instability problems with early superhet receivers. Sometimes the automatic gain control (AGC) line is down or is in trouble with decoupling capacitors open or leaky, and resistors open or high. Trace the AGC circuit and check and replace components.

What to do with hum? A slight hum can usually be put down to a faulty electrolytic filter capacitor. More severe hum problems warrant checking the rectifier valve or if there are faulty shields on other valves, particularly the detector/preamp.

Remember that one of your most useful tools is the small screwdriver: insulated, of course. Levering wires or components slightly may vary the hum or oscillation as their positions change. Then you know you are on the track of hum or feedback caused by high impedance leads or com-



What a sight! At left is the 6B8, a widely used multi-grid mixer/oscillator, and right, a 5Y3, a full-wave rectifier that enjoyed extraordinary popularity. We'll be talking more about valves, famous and infamous, in coming columns.

ponents too close to ones they shouldn't be close to.

European valves are particularly prone to microphonics. More often than not the valve must be replaced. But don't throw it away. In another set, it may not be microphonic!

A favourite test trick in the valve days, when the valves were of the types with grid caps on top, was to touch each valve cap in turn. When the indignant squeals of rage from the violated circuits stopped, you knew you had arrived at the dud stage.

The trap for young players, of course, was that sometimes European valves had the plate instead of the grid coming out the top. Then it was the finger-toucher who did the squealing when he copped the full high tension.

BEWARE when aligning receivers in case some coil-slugs are "live" with B+. This warning should be particularly heeded when you encounter a set which has trimmers at the top and bottom of the IF coil cans.

Summing up

For the serious valve hobbyist, most problems are routine, such as replacing "gone high" resistors, dried-out electrolytics and open-circuit or leaky capacitors, not to mention tired or dead valves.

Occasionally, a real stinker of a set comes along and these are mainly caused by previous tinkering in inexperienced hands. Many a set has been extensively butchered in trying to make it speak; usually you find these at swap meets.

Letters

This month we have interesting letters from two restoration enthusiasts.We welcome letters giving your suggestions or sharing your experiences. Address them to this column. We all like to hear from fellow enthusiasts. The first is from Garth Wells who has a few suggestions to make:

I have appreciated your magazine's addressing the great resurgence of interest in vintage radio. Indeed, I have been interested in collecting and maintaining vintage radios since I was a teenager some 30 years ago. And particularly as I am not involved in electronics, I thought it might be worthwhile sharing some of my views about future articles for the series.

Many technicians trained today in complicated electronics and transistor-based theory will have completely overlooked operating valve radios and receivers.

I suggest, first, a series that would basically retrain today's electronics technicians or yesterday's electronics experts on valve radio repair. This should be as simple as possible to help those like me who have no technical training. Maybe a reprint of an old series, modified, which appeared in past radio magazines may be appropriate.

Articles on alignment, using oscilloscopes, and/or signal generators would be much appreciated.

As all valve radios, except later models, cannot receive FM, an article on converting AM radios to FM using FM modules available and/or valve circuits would also be interesting and appropriate.

Articles on fault-finding and signal tracing could also be of advantage. A continuing series on classic radios with pictures, circuit diagrams, and possible valuations will also be of interest to most collectors and the public alike, I'm sure.

Also, a section for swapping or locating hard-to-find dials, speaker transformers, or valves could be interesting and appropriate. Also, publishing lists of suppliers for vintage radio components would be of advantage to all collectors.

I suggest you call Ray Kelly, current president of the Historical Radio Society and encourage him to include articles from his vast library of technical information and historical data.

I look forward to these and other articles appearing in your magazine and I'm sure many hundreds of new vintage radio collectors would also appreciate your concern and a more simplistic level of technical presentation in these articles.

Let's hope we can encourage many more younger people to be inquisitive and to help keep vintage radio collecting alive in Australia well after our generation has passed.

Also, articles on wind-up gramophones and repairing and maintaining them may be appropriate. Looking forward to future articles.

G. Wells,
North Sydney, NSW.

Your letter is most appreciated, and we have been happy to print your views. This sort of feedback we all appreciate.

Answering specific points: we would think that valve technology is so irrelevant to modern solid-state electronics it would be no use training technicians. Rather, encourage an interest among some so that they would be motivated to learn of their own accord?

The idea of an article on alignment is noted.

We're not sure of the value of introducing an FM component into a classic AM valve receiver: wouldn't that detract from its authenticity? If you want FM, a modern set is very cheap.

We like the idea of a swap column and we'll look at what we can do about it. If people are making a business out of selling vintage components, the onus is on them to use our advertising pages to promote their businesses. We are, of course, happy to receive news items from people in the business.

But on one point we must take issue. It would be one thing to restore the looks of a wind-up gramophone to the full glory of the Charleston, belt-driven motorbikes and cloche hats. It would be a crime deserving eternal banishment to Canberra to restore one to working condition.

The thought of a 300 g weight bearing down on a shellac disc - well, even a hardened and hissy old 78 doesn't deserve such a fate. And the excrutiating distortion from the acoustics, after our ears have been delicately nurtured on the highest of fi all these years, would be a form of torture that only politicians should be made to undergo, for their great sins upon humanity. A wind-up gramophone's sounds are of such a genre, like the unharmonious and hideously distorted caterwauling of a parliament of polies.

Enough soapbox! Here's what reader, Mr G. Sollers, has to offer.

It was with great interest that I read your recent column on "vintage restoration". While not a radio enthusiast myself, I have two rather large tape recorders of the early 1960s. When I say large, I mean 23 kg (50 lb) and 31 kg (68 lb), respectively. They are British Vortexions. That is, Ferrograph Mechanics and Vortexion Electronics.

They are almost identical; one is ½-track mono, and the other is ½-track stereo. In their day, they were considered "quality machines", and still are, while their specs do not match even quite ordinary cassette deck specs (40 Hz to 12 kHz, 60 dB s/n ratio, 3½ W RMS per channel output).

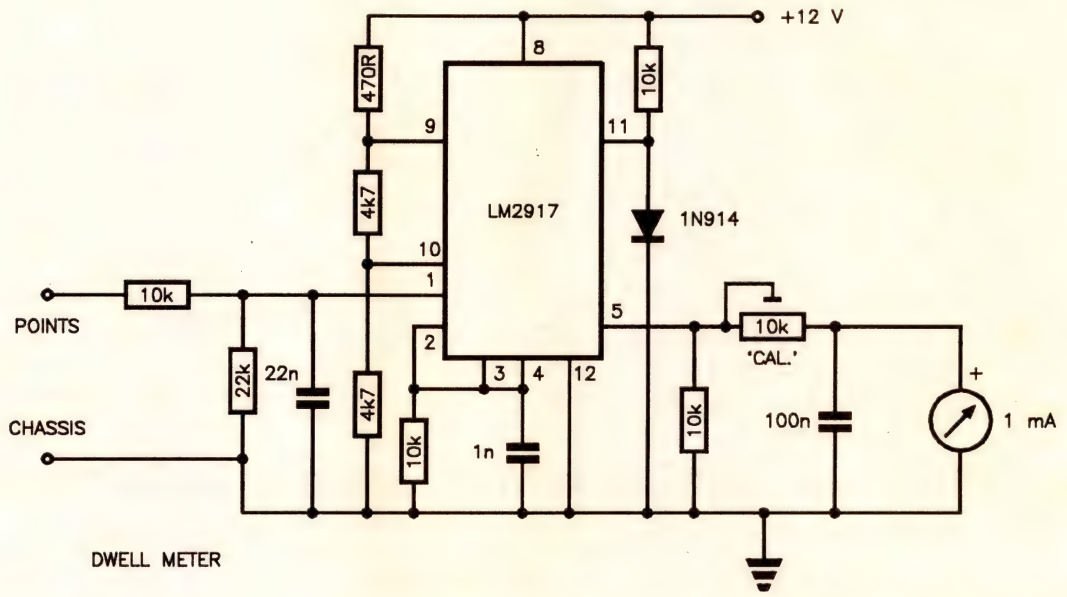
Their capabilities are quite outstanding. I use them in the theatre for sound effects for the local repertory society. Their robustness and versatility make them ideal for theatre work, and their power is more than adequate for our small theatre.

I have full circuits for each machine, and although Vortexion no longer exists, I was able to buy a spare capstan motor. spool motor, and capstan assemblies for them while visiting the UK some years ago. I also have a spare set of heads for them.

I used to work as an instrument maker on (handmade) tape heads and tape transports for very expensive research and industrial equipment, so I feel reasonably confident in servicing the mechanics. My electronics knowledge, however, is at hobby level, so I rely on magazines for that. Fortunately I have quite a few "Tape Recorder" magazines of the late 1960s which are a mine of information for the enthusiast. They also contain many circuits of valved and transistorised tape recorders of that era.

It is my intention to keep them going as long as possible, although they are in no way temperamental, neither have they ever let me down. The only maintenance done on them other than regular cleaning, has been that I rewired the deck to amp

• to page 118.▷



Vehicle dwell meter

National's versatile LM2917 has many automotive applications, is cheap and so easy to use. Fundamentally, its a frequency-to-voltage converter. Configured as a pulse mark-to-space ratio converter, it can be employed to measure the engine "dwell" angle in a vehicle; that is, the angle through which the cam shaft moves while the points are closed.

A 1 mA meter is used to read dwell angle. In this circuit, half scale reads 45° for a four-cylinder engine. It is readily calibrated with a square wave or pulse generator capable of a few volts of output. Use a 50% duty cycle (1-to-1 mark-space ratio) pulse to calibrate it, setting the 'CAL.' trimpot for half-scale reading on the meter.

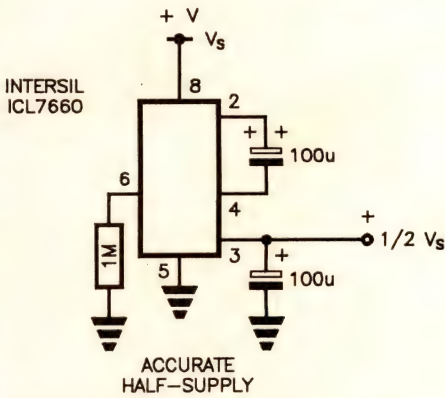
Charles Ray,
Hornsby, NSW.

Accurate supply rail 'splitter'

Many op-amps require positive and negative supply rails which gets to be a real hassle when you want to use them with other circuits that only requires a single supply rail, or where you only want to use a single supply rail. To get around the problem, you need to 'split' the single supply rail and generate a half-rail voltage terminal as a reference. Two resistors of equal value between the supply rail and ground is the simplest method, but many op-amp circuits require dc coupling and the half-rail point *must* be accurate.

Intersil's negative rail inverter, which was designed to provide a negative rail from a positive rail and of accurately equal voltage, can perform the required task using the simple circuit shown here. It delivers a split accurate to within ± 0.1%. Currents up to 80 mA may be supplied from pin 3.

B. Hamill,
Adelaide, S.A.

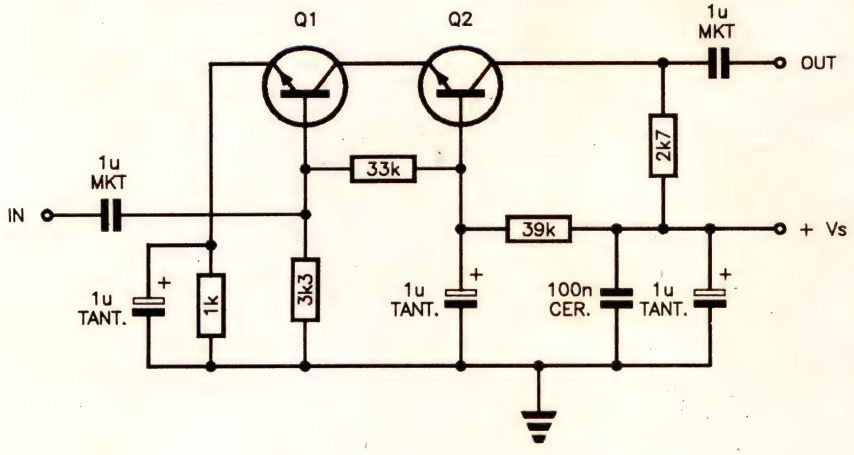


Wideband, high gain GP amplifier

This general purpose amplifier has multiple uses around the workbench or designed-in to many an application. It achieves a gain of around 30 dB and a bandwidth that extends beyond 4 MHz. Input impedance is a few kOhms;the output should not be loaded with more than 10k.

The input and output 1u capacitors should be 50 V metallised polyester (MKT) types; the other 1u caps should be tantalums, as indicated. The two transistors may be any of a whole variety of devices, e.g: 2N2369, 2N5769, 2N5772, 2N706 etc. It may be powered from a supply ranging from 5 V to about 30 V.

Richard Lovett,
St. Lucia, Qld.



3RD BIRTHDAY CONTEST No.4.

Video fans – cast a Captain Cook at this!

Imagine winning this magnificent monitor-style 48 cm Sony Super Trinitron black screen TV, model KV-1982AS, worth $1149.

This stylish black-finish 48 cm TV receiver features Sony's Super Trinitron system, which uses an Aperture Grill screen in conjunction with a new computer-designed Panfocus Gun. Sony's one-gun three-beam technique is fundamentally different from the shadow-mask system used in most TVs, and is designed to produce sharper, brighter images with more precise colour, and freedom from the unpleasant "doming" effects which cause colour impurities.

The screen is flat and square-cornered, and includes an on-screen display to make the full-function infrared remote control even easier to use. Video (BNC) and audio (RCA) inputs are supplied for true monitor capabilities.

Prize kindly donated by Sony Australia.

CONTESTS CLOSE 31 OCT. 1988

1) Which came first, the Cathode Ray Oscilloscope or Electronic Television?

. . . . . .

2) In what year did Sony commence manufacturing televisions?

. . . . . .

3) Would you expect the aperture grille or conventional shadow mask television system to produce a clearer picture?

. . . . . .

Now, in 25 words or less, explain why you would like to win the Sony KV-1982AS Monitor Style Television.

I have read the rules of the contest and agree to abide by their conditions.

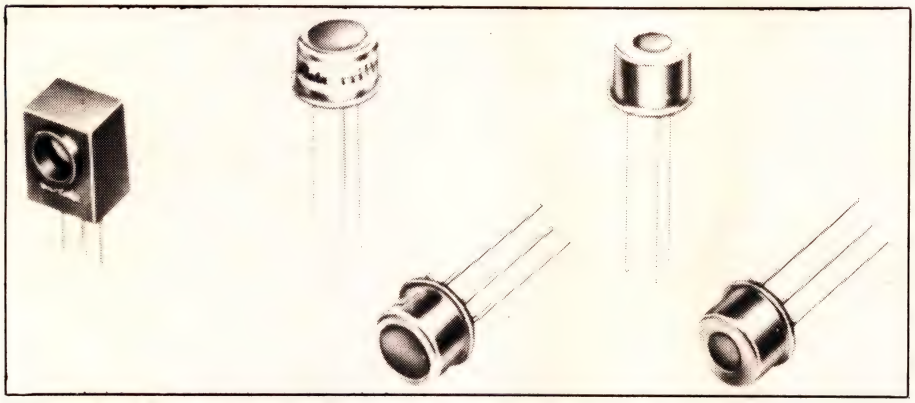
Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____



Pyroelectric IR sensors

Excellent performance is claimed for pyroelectric infra-red sensors using a ceramic titanic acid lead element. The series is said to show stable sensitivity in a wavelength range of from 0.2 to 20 µtype, the pyroelectric IR sensors do not need cooling, and therefore have many applications. It responds quickly with built-in FET for impedance conversion, to detect people, flames and visible light.

The eight models have dual and single elements, and the resin case types give three window materials: polyethylene, silicon and 7 µm a for simple security systems, switches for lighting and home appliances.

The hermetically sealed type have three window materials: silicon, 7 µm and 4.3 µm filters for security systems, accident prevention equipment, automatic doors, analysing equipment, measuring laser power and temperature measuring equipment.

Find out more from **IRH Components, 32 Parramatta Rd, Lidcombe, 2124 NSW. (02)648 5455.**

Logic a powerful design tool for ASICs

Claimed to be one of the most advanced IC design tools currently available in logic synthesis, the VLSI Technology Logic A is an enhanced version of the State Machine Compiler.

It is said to be the only such product currently available to give output in a form to implement as the best programmable logic array (PLA) structure within an ASIC, as well as in a netlist form for implementing either as a gate array or cell-based device.

It automatically generates high fault coverage test vectors for the logic generated. These in turn are automatically combined by the VLSlector test development tool with other module tests on the chip to create a comprehensive device test program. This capability can reduce test program development time from weeks to hours.

Posistors. Huh?

A PTC resistor designed to protect high power semis has a logarithmic increase in resistance with a small increase in temperature over preset detection temperatures. Hence the name.

Many advantages are claimed for posistors over electromechanical devices. Posistors are compact, lightly built, and so respond rapidly to thermal change.

As they're solid state devices, they are immune to mechanical vibration and impact problems.

More information is obtainable from the distributor, **IRH Components, 32 Parramatta Rd, Lidcombe, 2141 NSW. (02)648 5455.**

Peripheral chip

Said to be a highly integrated multi-channel, multi-purpose peripheral I-O device, the Z84C90 serial/parallel/counter/timer (SPCT) has been released by Zilog.

Designed in low-power CMOS processing technology and operating at an 8 MHz clock frequency, the chip allows the designer to optimise silicon-efficient high performance applications with just two chips: the SPCT and Zilog's Z80 CPU.

Contact the Marketing Division of the **George Brown Group, 456 Spencer St, West Melbourne 3003 Vic. (03)329 7500.**

More ISOTOP packages

Several of Philips' high-power epitaxial and Schottky-barrier rectifiers, thyristors, GTO (gate turn-off) thyristors, Darlingtons and switching transistors are now available in the plastic ISOTOP power package.

The package is backed by both Philips and SGS-Thomson Microelectronics. It offers the best power rating to package volume ratio currently available, Philips says.

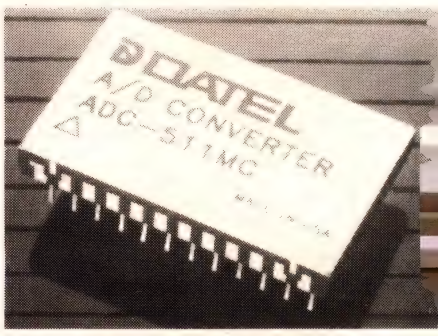
It is said to be the only plastic power package on the market that can handle more than 1 kV and carry 100 A in a volume of 6 cm^3. The package withstands temperatures between - 65° and +150°C and claims better resistance to moisture than metal packages. You will find **Philips Elcoma at 11 Waltham St, Artarmon 2064 NSW. (02)439 3322.**

Multi-tap video shift register

For high resolution graphics systems, the Bt424 250 MHz, 40-bit multi-tap shift register is said to be unique because it was designed to adapt to various frame buffers and RAMDAC architectures to simplify system design and reduce component count.

The Bt424 loads pixel data from the frame buffer at standard low speed TTL thresholds. Data are then transferred from the input latch to the shift register using an ECL compatible load signal. Because the part uses both TTL and ECL circuitry, it solves the typical design problem of low-to-high speed interface and simplifies system tuning.

The Bt424 was released by Brooktree of California, USA, whose products are distributed in Australia by **Energy Control 26 Boron St, Sumner Pk, 4074 Qld. (07)376 2966.**



New Datel A-D converters

Datel's two new 12-bit 800 ns A-D converters with internal buffer amplifier are identical except for the analogue input voltages. The ADC-520 features input voltage ranges of ±10 V, and 0 to +10, +20 and -20 V. The ADC-521 includes voltage ranges of ±2.5 V and 0 to +5 V.

Other features include extremely low initial errors of ± 3 LSBs highest for offset and gain errors, CMOS/TTL compatibility, three-state outputs, and highest power dissipation of 1.9 W.

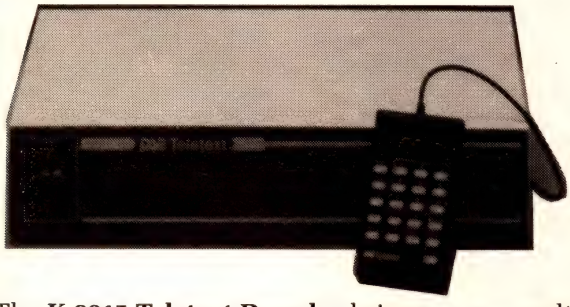
Elmeasco has more details. Contact them at **12 Maroondah Hwy, 3134 Vic. (03)879 2322.**

Win these four great Dick Smith kits

Win these first-class kits from Dick Smith Electronics – so good your friends won't believe you built them!

These top-line "high tech" kits will provide the winner with units equivalent to or better than the expensive commercial built-up alternatives, with the priceless bonus of the satisfaction of "doing-it-yourself".

Prizes kindly donated by Dick Smith Electronics; value – almost $1000!



The **K-6315 Teletext Decoder** brings you a wealth of information on your TV screen. The Teletext signal is already being transmitted to millions of homes around the country, carried on the "unused" lines between TV frames and thus normally "hidden". Only those with expensive Teletext TVs, or decoders such as this one can unlock the hidden signals.

News pages and reports on many various activities are broadcast, with one of the most significant services being the provision of captions to popular programmes. This service for the deaf or hearing impaired is available on programmes which display the Caption Centre logo. Do you like a "flutter" on the races? Get your betting information on Teletext!

The Teletext decoder is designed to operate into a standard home VCR, but can be used without one if you build the **Teletext Tuner (K-6319).** This device takes the decoder output and feeds it straight to your TV for no-fuss reception of the teletext material. The kit is simple to build, with very comprehensive instructions, and tuning is a simple matter of selecting the right channel. The tuner can even be built into the Teletext Decoder for maximum utility.

The **K-3437 1 GHz Digital Frequency Meter** provides specifications unheard of in commercial units of only a few short years ago, but with an assembly technique ideally suited to home construction. Frequency measuring range is from 20 Hz right up to a stunning 1000 MHz!

Hi-Fi with maximum convenience is yours with the **K-4003 IR Remote Control Preamp** kit. Not only do you get an eight-input hi-fi preamp with oodles of indicator LEDs and an output suited to most amplifiers, but you get full control over it with a 21-button IR remote control. So sit back, put you feet up and let your fingers do the walking!

CONTESTS CLOSE 31 OCT. 1988

1) Where in a television transmission is the teletext information located?

. . . . . .

2) Name the last three Managing Directors of Dick Smith Electronics, in chronological order.

. . . . . .

3) What product from Dick Smith Electronics has the catalogue number N-1081 and what other product would you use this with?

. . . . . .

In 25 words or less, why do you want to win these four kits from Dick Smith Electronics?

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

At last, an affordable mouse

A squeal, sorry, a steal, at $99, Electronic Solutions' mouse is claimed to have high performance and industry standard compatibility.

This new mouse is a serial type that interfaces with all the popular packages and automatically selects between Microsoft and Mouse Systems and comes with software to test, set up and operate.

Features claimed include: extra high resolution, 290 dpi and up; selectable baud rate — 1200, 2400, 4800 and 9600; best mechanism, with ball on centre; super tracking speed — 600 mmps and up; accurate optical rotary structure; and antistatic silicone rubber ball.

Write to **Electronic Solutions, P.O. Box 426, Gladesville, 2111 NSW. (02)427 4422.**

See it all

Said to be ideal for broadcast monitoring, CCTV, medical imaging and others, the 23 cm case composite general purpose TE-901K monitor offers 1000-line resolution and 20 MHz video bandwidth.

Weighing 6.65 kg, with convenient handle and dual 240 Vac/12 Vdc power requirements, the unit can be used in the field. It is also available in 19" rack-mounting configuration. A wide range of phosphors is available.

Further details from **Thomas Electronics, 12 Larkin St, Riverwood, 2210 NSW. (02)53 0721.**

Two plotters

Complementing its 18-series pen plotters, Schlumberger has two cutsheet models accepting any size paper from A4/A up to the machine's capacity.

The models are the 1834-S (A1 size) and 1835-S (A0 size), and suit architectural, mechanical, CAD/CAM, pc board, cartography, PERT charts and more.

Standard features include the plot buffering system where a quick download of the plot file leaves the host free for another task while the plotter continues.

First class plot quality is offered with new patented head technology, and superior throughput is generated by pen speeds as high as 120 cps. A curve smoother reduces the start/stop/start pen smears.

More information is obtainable from **Schlumberger Technologies, 33 Berry St, North Sydney, 2060 NSW. (02)957 2015.**

Powermate gets four new mates

Several new computers have joined NEC's range: beginning with the high-end 386/20 featuring Intel's 20 MHz 80386 microprocessor supported by 2M of high-speed, zero-weight-state memory.

Following is the Powermate 1 SX, based on the Intel 80386SX. It is price positioned to offer 386 performance for the price of the 286.

The Powermate Portable SX incorporates these: first to feature the 80386SX; among the first portables to provide three full length expansion slots; 93-key keyboard; 2M RAM standard and expandable to 10M; and first portable to incorporate the VGA graphics standard on a gas plasma screen.

The fast Powermate I Plus is based on the 12 MHz 80286 microprocessor with zero-weight-state memory.

Further strengthening the Powermate range, the Multisync GS is a high resolution monochrome monitor that can provide VGA graphics with up to 64 grey scales, and the Multisync II VGA compatible colour monitor.

There are software applications and operating systems including Microsoft OS/2 operating system and MS-DOS 3.3, and Windows 386.

For more details: **NEC Information Systems, 99 Nicholson St, St Leonards, 2065 NSW. (02)438 3544.**

Handheld logic

Handheld and battery powered, the LogicBridge 136 performs as a dedicated logic instrument for those designing, repairing or maintaining digital electronic circuits and equipment.

Saving hours of lab work , fast waveforms are said to be easily identified by taking a "logica snapshot". Also, retrieve data from memories for later review ing and analysing.

The waveforms are viewed and measured on a custom high resolution LED display which simulates binary level signal/channel traces as displayed on a logic analyser's CRT.

The effective real time bandwidth of the model 136 is 10 MHz, but the glitch catche function allows for capturing pulses down to 50 ns.

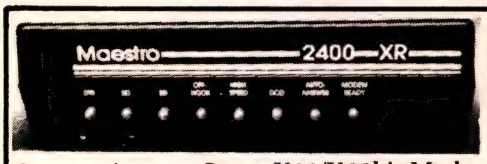
It has useful digital debugging signal identifying and tracing facilities. The audio output may be used for showing an occurrence of trigger and for identifying actual wave shape.

Follow up at **Emona Instruments, 86 Parramatta Rd, Camperdown, 2050 NSW. (02)519 3933.**

UV EPROM eraser

Claiming to combine high efficiency with low cost, the Bytek BUV-3 family of UV EPROM erasers are housed in rugged steel enclosures.

The rated average life of the UV lamp is about six months



The MAESTRO 2400XR Here's a fully-featured, Hayes compatible, 1200 and 2400 bps full duplex modem for just **$369 (incl. tax).**

This modem uses the LATEST in DSP Chip Set technology and microprocessor control, bringing you the future TODAY.

Super price on a Super V.22/V.22bis Modem!

Don't Wait! RING NOW!
(043) 68 2277, or (043) 68 2278.

Maestro Distributors
Calool St. Sth Kincumber 2256 NSW

continuously operated, and its state is reliably shown with a built-in UV glow indicator that replaces conventional pilot lights and add-on UV lenses.

The 250 mm wide drawer with integrated handle can hold up to thirty 24-pin chips at a time, and a conductive foam pad protects them from electrostatic charge build-up.

Further information can be gleaned from **Parameters, Centrecourt, 25-27 Paul St Nth, North Ryde, 2113 NSW. (02)888 8777.**

Dot-matrix printers

Higher quality, performance and greater versatility for price are claimed for NEC's new dot-matrix Pinwriter P5200 and P5300 printers which are designed with applications in desktop publishing and eight-colour graphics in mind.

New features include built-in push tractor and envelope feed, a tear-off bar, print speeds of 95 cps (letter quality) or 265 cps (draft quality), fabric or multi-strike film ribbon and 80K buffer.

A modular serial interface enables the printers to operate in industry-standard PC and UNIX environments.

They have up to 36 fonts using bold, italic and other modified variations, which are supplemented by optional font cards like a credit card, that fit into a slot in the machine.

An optional snap-in colour printing kit and the maker's four-colour ribbons can be used to create eight-colour material.

More info from **NEC Information Systems, 99 Nicholson St, St Leonards, 2065 NSW. (02)439 6584.**

CAD and mouse package

A CAD package, the CCS designer, can enlarge, rotate, zoom, paint, fill, undo, redo, flip, move, copy, delete and save sections of drawings.

With an rrp of $299, the designer — including mouse - brings CAD software within even the hobbyist's reach to create professional quality designs and drawings, according to the distributors.

Interested? Contact **Electronic Solutions, P.O. Box 426, Gladesville, 2111 NSW. (02)427 4422.**

Atari plays CD-ROM

Able to read up to 540M of data, Atari's CD-ROM player connects to the Atari ST and MEGA computers and will transmit data at speeds up to 10M.

When you aren't watching your screen, the unit plays music via headphones or speakers that plug into it.

Atari said it was designed to offer a flexible approach to data retrieval, and it and associated operating system extensions conformed to the High Sierra Group standards.

An associated MS-DOS card was currently being prepared to interface the unit with PC-compatible microcomputers.

When it comes into computer speciality dealers in the final quarter of the year its rrp should be $1199, and used with the Atari 520ST would cost buyers less than $2400 for a complete CD-ROM display station.

Versatile EPROM burner

Electronic Solutions has just released a powerful EPROM burner with "drop-down" menu software. The device has extensive help facilities which makes the user's task easier, the company says.

It is suitable for blowing most popular EPROMs and comes with a high quality ZIF (zero insertion force) socket and cabling, with facility to add three more sockets if necessary.

Facilities include the ability to read, write, copy compare, and erase the contents of EPROMs. It can also verify data and even combine the data in two smaller EPROMs into a larger one.

The unit can cope with 2716, 2732, 2764, 27128, 27256, 27512, 2804, 2816, 2864, 58064 devices.

Full details from **Electronic Solutions on (02)427 4422.**

MCA (More Computer Acronyms)

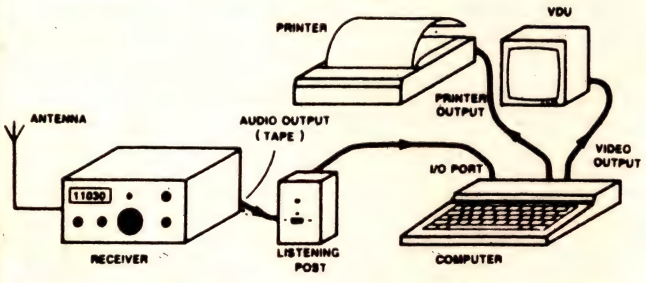
Diflo Publications has released "Computer Abbreviations, Acronyms and Such", a text listing over 2500 abbreviations and other buzzwords used in the computer industry.

Indistinguishable acronyms and obscure instructions are the bane of computer users, so this Australian written, published and printed volume should find a ready market.

BASIC, MS-DOS, and CP/M commands are included, along with conversion tables for binary, hex, octal and decimal and for ASCII to EBCDIC etc.

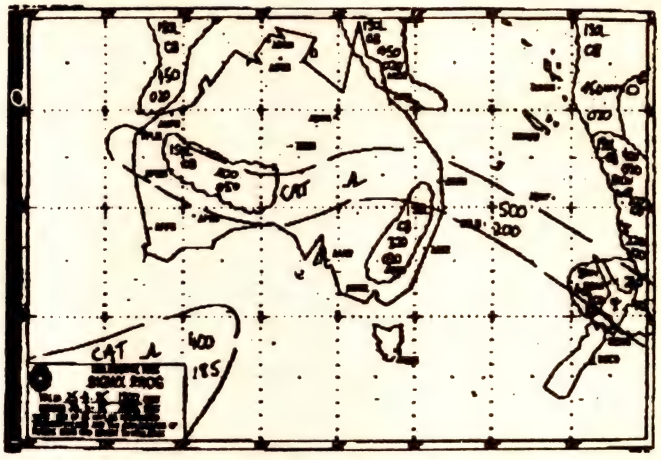
"Computer Abbreviations, Acronyms and Such – The Microcomputer User's Guide" was written by Paul Black and is published by Diflo Publications.

RECEIVE WEATHER FAX, RADIOTELETYPE AND MORSE CODE TRANSMISSIONS USING YOUR COMPUTER



Build the Australian Electronics Monthly "Listening Post" (AEM3500), a simple add-on decoder project – it goes between the audio output of a HF (shortwave) communications receiver and the I/O of your Commodore 64 or Microbee computer; software then decodes the transmissions for you. Print weather maps, foreign news service broadcasts, amateur and commercial radioteletype or Morse transmissions. *

Fascinating! Useful, too.



FAX picture

SOFTWARE ONLY: $25.00
– includes all instructions on the decoder & s/ware.

LISTENING POST "PACKAGE": $35.00
– you get software, quality fibreglass pc board with component overlay and full how-to-build instructions plus software operating details. (Components are widely sourced by electronics retailers).

*C64 software does not provide Morse decoding.

Send coupon to: AEM Software Service

Send us a blank C10 cassette or a formatted disk for us to transfer the software onto.

SEND ME THE LISTENING POST:
☐ SOFTWARE ONLY
☐ FULL PACKAGE

My computer & printer are:
☐ Microbee/C.Itoh 8510-type
☐ Microbee/"Epson" FX80-type
☐ C64 or C128/(most printers)

I am paying by: ☐ Cheque ☐ Money Order ☐ B/card ☐ M/card ☐ Visa
(Make out cheques or money orders to: Aust. Electronics Monthly)

Card No ..... Expiry .....
Signed .....
Name .....
Address .....
..... P/code .....

Give Your PC AT/Clone Computer the SMARTC

Get the new XE1287 SmaRTC!

Remember the famed SmartWatch? Well, Xecom Inc. in the States has just released the XE1287, real-time clock with RAM.

This nifty little chip is a direct replacement for the MC146818A found in most AT compatible computers. As some AT owners might have encountered, sometimes the Real Time Clock (RTC) and CMOS RAM in their machine mysteriously 'fails' and resets itself. The time, date and the machine's configuration (what type of hard disk, display adaptor you have, etc.), are all wiped!

What a hassle configuring the system every time you turn it on!

So? Is the XE1287 really worth it?

Well, just like its little brother, the SmaRTC has its own miniature lithium power source which will retain the time of day and its 50 bytes of RAM for 10 years in the absence of power. The chip in fact replaces 16 components in a normal installation!

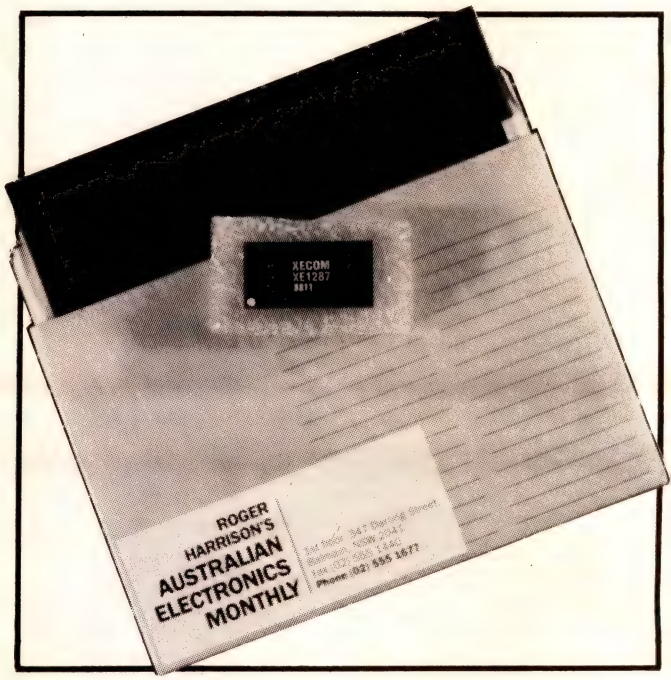
Just like the revolutionary Smartwatch for the PC-XT/Clones, the SmaRTC for the PC-AT/Clones is housed in a piggy-back 24-pin dual in-line package and is as easy to install as an IC! How could you go wrong?

Yes, it really has the SMARTC!

The SmaRTC even compensates for leap years and daylight saving (not applicable in Queensland!). The internal clock can be run in either 12 or 24 hour mode; when in 12 hour mode am or pm indication is shown. Emulation of Intel or Motorola bus timing is also selectable.

JUST $49.95

plus $8.00 delivery



See the Data Sheet in this issue for more details!

To order your XE1287 SmaRTC,

EITHER

Fill in the coupon below and send a cheque or money order to:

AEM SmaRTC Offer,
1st Floor, 347 Darling St
BALMAIN 2041 NSW.

OR

Phone (02)555 1677 and 'pledge your plastic'

As a bonus for purchasers of the XE1287 SmaRTC, Energy Control will despatch a disk with useful utilities for the SmaRTC and your computer.

This offer is being made by Energy Control International P/L and AEM is acting as a clearing house for orders.

OFFER EXTENDED TO NOVEMBER 31 1988

Yes, please send me . . . . XE1287 SmaRTC's at a cost of $49.95 + $8.00 for delivery.

I am paying by ☐ Cheque ☐ Money Order ☐ B/Card ☐ M/Card ☐ Visa.

Cheque/Money Order No.: _____

Credit Card No.: _____

Signature: _____

(unsigned credit card orders cannot be accepted)

Name: _____

Address: _____

_____ P/Code: _____

Phone: (____) _____

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Speech as a man-machine interface – recognising speech in noise

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Few people have any experience of communicating verbally with computers and even fewer have ever done so in a noisy environment. Yet in a factory or when using a telephone in a busy office, recognising and decoding speech is a familiar problem.

IT WILL TAKE many years of research before the most efficient form of man-machine interface will be evolved, though the task has to be tackled if we are to be able to talk to computers against a background of machinery, in a motor car or on a flight deck. Headway is already being made in analysing the difficulties and outlining ways to overcome them.

Speech dominates human communication. If we want people to do something, or we need certain information from them, we simply speak to them. If they are far away we may write them a letter, but most people prefer to pick up a telephone, perhaps because reading and writing seem much more complicated than speaking and listening. This is hardly surprising, for it takes years of practice at school to become proficient in the skills needed to read and write.

When we want to communicate with a machine we have to learn new skills. We need to know how to poke at a keyboard with our fingers and to watch the effect it has on a screen. How much easier it would be if we could simply speak into a microphone to get the machine to do what we wanted!

This dream occurred to speech technologists years ago, and for the last 20 years or so they have been trying to devise techniques for getting machines to respond effectively to speech signals.

How we speak and how we listen

Speech communication appears to be a simple process. It is learned by every healthy child with little or no effort. In reality it is not simple, it is a most complex process. An idea in the mind of the speaker must first be expressed in a language understood by both him and the listener. It must then be articulated. We do it by modulating the airstream from the lungs by the vocal chords to produce a sequence of pulses whose frequency determines the intonation.

The pulses excite the resonances of the vocal tract and then radiate from the lips as a sound wave. The meaning of the sentence is coded in this wave by subtle movements of the tongue, jaw and lips. These complex movements are known to everyone who has learned the language.

But this is only half the story. The sound passes through the outer ear of the listener and causes the eardrums to vibrate. These vibrations cause the ossicles, a series of small bones attached to the eardrum, to move and pump fluid in the cochlea, or inner ear. In the cochlea is the basilar membrane which oscillates at various places along it which depend upon the frequencies present in the input signal.

So, the structure of the inner ear begins the process of decoding the speech wave. Attached to the basilar membrane are a large number of hair cells, some 30 000 of them, which activate nerve cells when they bend. These cells are the first stage in a complex system which leads up the brainstem and eventually to the auditory cortex.

Automatic recognition

So far, the process by which the speech signals are decoded by the brain are not understood, so programming a computer to recognise speech in the same way that the brain operates is obviously impossible.

Nevertheless, for many practical purposes a machine which recognises just a few words can be very useful. For example, consider a program that displays the choices available to the user by means of numbered menus. If the machine can just recognise the spoken digits the user can complete his task by voice.

Most practical speech recognisers work by pattern matching. The user speaks all the words in the machine's vocabulary and the machine analyses them and stores the result. These stored patterns are often known as templates. When an unknown word is spoken, the machine compares this new utterance with each of the stored templates and chooses the one which gives the best match.

Several techniques have been employed to analyse speech signals. We know that speech is encoded in terms of frequencies and that the human auditory system begins its analysis of sounds by separating them into their component frequencies, so spectral analysis is a popular technique.

The upper of the two illustrations shows a sound spectrogram, or sonagram, of the word 'recognition'. Frequency is represented by the blackness of the picture. The dominant frequencies, known as the formants, can be seen as the black horizontal bands. These reflect the resonances of the vocal tract.

Problems

Speech recognisers built on these principles alone are not very successful for three reasons:

(1) Every time we utter a word we speak at a different rate, so some patterns are spread out in time compared with others. ▷

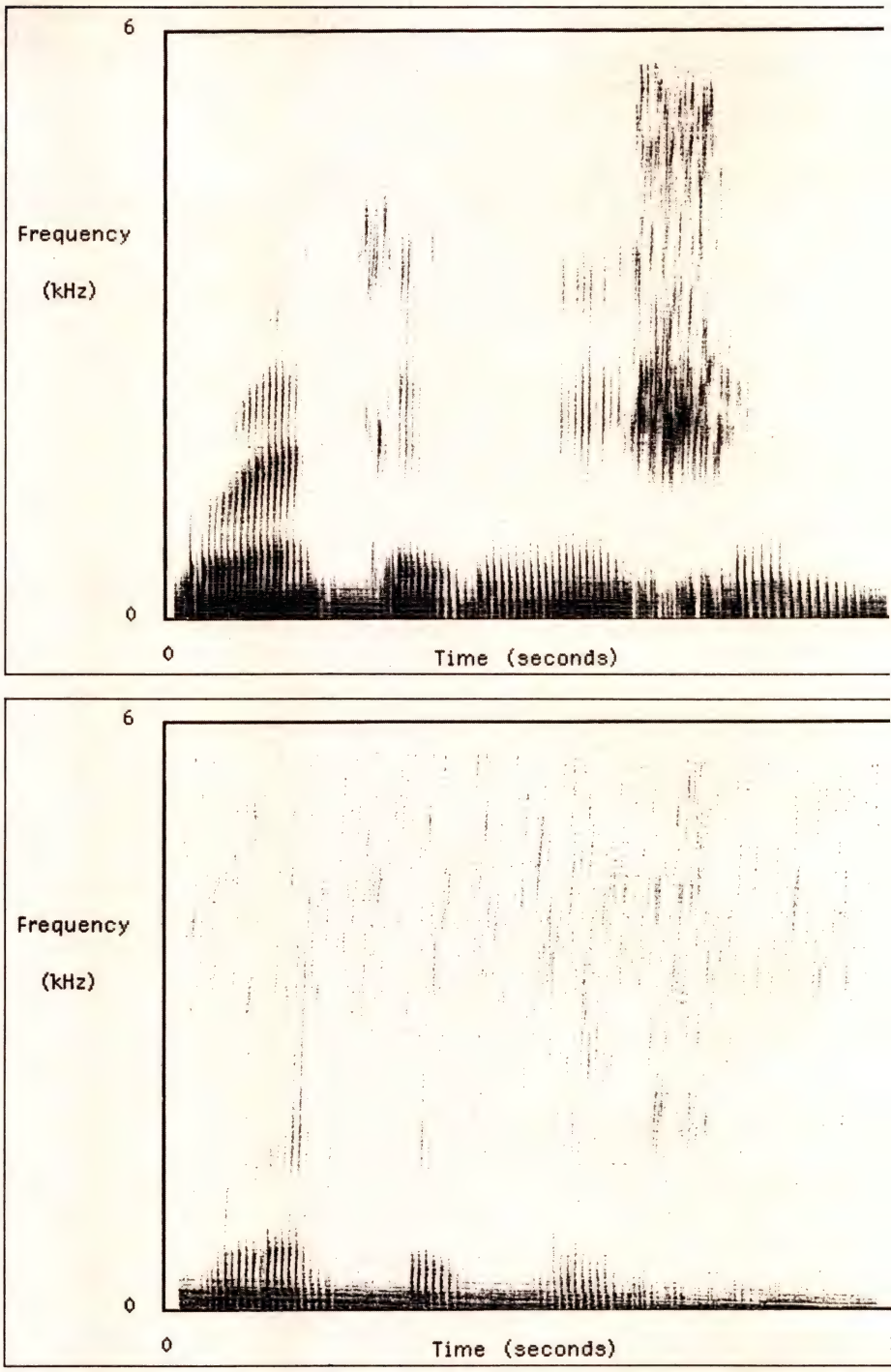
(2) Different people have different sized vocal tracts, so the formants occur at different frequencies when they say the same word.

(3) Most speech communication takes place not in isolation, but against a background of other noises.

Various techniques have been devised for dealing with these problems. The first problem can be dealt with by so-called dynamic time warping. This enables the stored templates to be expanded in such a way that the optimum match is obtained. Alternatively, the problem can be dealt with by building statistical models of each word which incorporate the variability of the utterances.

Usually the multi-speaker problem has been circumvented by training the system with the voice of the user, but there have been some attempts to cope with it by building transformations for each new speaker that enable his voice to be transformed into one like that of the person who originally trained the system. Here, statistical modelling of the variability has again been used.

The problem of recognition in noise has not yet been solved. John Bridle and his colleagues at the UK Royal Signals and Radar Research Establishment in Malvern, western England, some years ago showed that a speech recogniser which worked well in the quiet recognised only about 50 per cent of spoken digits correctly. When the signal-to-noise ratio was +3 DB (decibels). This is far worse than human performance. It has been known for may years that spoken digits can be recognised with almost complete accuracy with a signal-to-noise ratio as poor as -6 dB, which means the intensity of the speech is much less than that of the noise. A sonagram of the word 'recognition' with a signal-to-noise ratio of -6 dB is shown in the lower of the two illustrations.



Sonagrams of the word 'recognition'. At the top it is spoken against a quiet background, and above with a signal-to-noise ratio of -6 dB.

Auditory monitoring

The superior performance of people in recognising speech in noise has led to the suggestion that speech analysers which operate on the same principles as the human auditory system might work better than those based on conventional techniques. Preliminary experiments by Dr Ghitza at the Bell Laboratories in the USA and others elsewhere have shown promising results.

Our Department of Communication and Neuroscience comprises a number of research groups which investigate the mechanisms of vision, hearing and speech. Professor Ted Evans, the head of the department and leader of the Auditory Physiology group, has developed an electronic model of a single channel of the auditory system. It gives responses similar to those obtained by inserting micro-electrodes in the auditory system of cats.

Professor Evans's model consists of a filter with characteristics that simulate those of the inner ear, a half-wave rectifier and a logarithmic compressor to represent the action of the hair cells, and what is called a probalistic spike generator to simulate the production of action potentials in nerve cells.

Our Speech and Auditory Physiology groups are collaborating with Dr Pat Wilson of the Auditory Psychophysics group to produce a computational model of the auditory system with 100 or more channels. This work is being made possible by a grant from the UK Science and Engineering Research Council to install a fast computer that will enable the model to process signals, especially speech, in a reasonable time.

The first stage of the model consists of a bank of band-pass filters which stimulate the signal processing as far as the auditory nerve. The characteristics of these filters are estimated by a process known as reverse correlation. A random noise signal is applied to the auditory system and responses are recorded from the auditory nerve by means of a micro-electrode. The

noise signal causing the nerve fibre to respond is also recorded.

By a process similar to cross correlation between the noise input signal and the response of the nerve fibre, the impulse response (the response of a filter to a single impulse) of the auditory fibre is found (in practice the impulse is reversed in time; hence the tern reverse correlation). Several experiments have to be dome with a number of nerve cells, each tuned to respond to different frequencies, to develop the impulse responses of a bank of filters.

These impulse responses can be programmed on the computer and used to simulate the filtering characteristics of the auditory system. The other stages of auditory processing, logarithmic compression and rectification by the hair cells and the generation of spikes according to a probability function, can also be programmed. The result is a computational model which allows the signals generated at each level in response to speech sounds to be studied.

The auditory system is more complicated than I have already outlined. Recent physiological studies have shown that there are interactions between the channels: if there is activity in one channel, the activity in neighbouring channels is suppressed. The mechanism might be responsible for reducing the effects of noise while enabling speech signals to be transmitted to the higher regions of the auditory system. We intend to build lateral suppression into our model and to investigate what effect it has on speech processing.

Speech synthesis

Techniques for speech synthesis were developed twenty years ago. In a typical system a sentence is first translated into a sequence of phonetic units, which represent the way in which each sound is pronounced. This can be done by looking up each word in a phonetic dictionary or applying a set of context-sensitive rules (for example *p* followed by *h* is pronounced *f*, otherwise *p*).

The phonetic units are then translated into acoustic parameters which represent the physical characteristics of the sounds. The acoustic parameters are the frequencies of the formants (see left-hand illustration), their intensities, and their durations. They are used to control a set of resonators excited by a sequence of pulses.

Although such a system produces intelligible speech, the output sounds rather mechanical. Moreover, it has been found that when it is heard against a background of noise it is a great deal less intelligible that equally loud natural speech. We are collaborating with the IBM Scientific Centre in Winchester, southern England, to try and discover why this is so.

One possibility is that whereas this system faithfully models the resonances of the vocal tract, it does not employ realistic excitation pulses. A technique known as inverse filtering is being used to measure the shapes of the excitation pulses in human speech.

In this technique we are able to study the variation in the shape of the excitation pulses. This knowledge can be applied to speech synthesis. We expect that speech synthesised in this way will be more intelligible in the presence of background noise.

The user interface

When the captain of a ship gives a compass course for the helmsman to steer, the helmsman repeats it back to confirm that he has heard it correctly. When a telephone operator is asked to obtain a number she repeats the number back.

Communicating in a noisy environment is somewhat similar. The noise may corrupt the speech signal and cause an error in recognition. The user will be unaware of the mistake unless the words are displayed on a screen or the machine is equipped with a synthesiser to speak to him. If the user is communicating over a telephone line, or if his eyes are busy with another task, the latter course may be the only one that is practicable.

The question arises as to whether the response of the recogniser should be checked after each word has been spoken to it or whether it should be checked later, for example, at the end of each sentence. Compass courses always consist of three digits and they are repeated back as a group. Telephone numbers, on the other hand, vary quite widely in the number of digits they contain. They are often checked after three digits, but on a bad line digits may be checked one by one.

Here at Keele we are interested in communicating with computers in a noisy environment where it is likely, in spite of advances in recognition from auditory modelling and in synthesis from realistic excitation pulses, that occasional mistakes will be made. So we are interested in finding the most efficient ways of detecting and correcting errors.

We have developed a mathematical model of the user interface, which enables us to arrive at the optimum number of words which should be spoken before any checking is done. This model predicts, as it might be expected, that as the noise level rises and the frequency of errors increases, the number of words spoken before a check is made should be reduced. Experiments have shown that the specific predictions of the model are borne out in practice.

Future plans

Our research is by no means completed. We have only recently acquired computers powerful enough to carry out the work. When even more powerful ones come into use, progress will be faster.

Advances are continually being made in understanding the physiology of the auditory system. We intend to incorporate these developments in future auditory models and to test their utility in automatic speech recognisers.

Our programme in speech synthesis has been hampered by a lack of knowledge as to how the shape of the excitations pulses varies in natural speech. We are gradually acquiring this knowledge, and in due course it will be transferred to our speech synthesis system.

VZBUG – A useful program for memory related work on the VZ200 or VZ300

Have you ever wanted to look inside a VZ memory chip? There are two ways to do this. The first is to get a hacksaw and cut the chip in half. The second method is to use VZBUG. We think you'll find VZBUG much more informative than the hacksaw.

ONE OF THE DISADVANTAGES of the modern home computer is that the user never really gets the opportunity to get into the guts of the machine. Most of the time the small home micro is in BASIC mode, and the user doesn't have any idea why the computer does what it does. VZBUG remedies this by letting you get into the "nitty-gritty" of your VZ's insides.

VZBUG is ideal for fixing jammed programs, or for other memory related work. In addition, you can use VZBUG for loading and saving data onto cassettes, clearing the screen, typing text into memory and printing it – a mini word processor!

Once you have VZBUG installed you will wonder how you ever got on without it.

Functions

There are seven main functions in VZBUG. All numbers are entered from the keyboard in hexadecimal. The functions are called after the program is loaded with the following commands:

C – Clear screen
G – Goto memory location and execute program
I – Insert ASCII into memory
L – Load from cassette
D – Display memory location
O – Output memory
S – Save to cassette

To terminate the program and return to BASIC, simply enter **G1A19**, which translates to "goto HEX 1A19 and execute". 1A19 is the return-to-BASIC address contained in the VZ ROMs.

Clear screen – just type "C" and the screen clears, returning the prompt character to the top left hand corner of the screen.

Goto – type "G" and the computer will ask you for a memory location. Enter the location in HEX and the computer will jump to that location and execute what i there. If there is not a valid program at that address the computer might lock up, so be careful.

Insert ASCII into memory – type "I" and an asterisk will appear on the screen. Enter the start address (again in HEX), and start typing. This is in effect a mini word processor. To exit the command and return to the VZBUG command loop, simply type CTRL "E".

Load cassette – typing "L" will result in the word "WAITING" will appear on the screen. Press PLAY on the cassette player and the next program on the tape will be loaded, in the same manner as the BASIC CRUN command. CTRL BREAK will terminate the load and return you to BASIC.

Display and alter memory – this command allows you to display and alter any memory address in the VZ RAM area. Type "D" followed by the address you wish to access, e.g. **DCF00** will display the contents of memory location CF00. If you wish to change the contents, simply type in the new data, in HEX of course. If the data typed is O.K., press RETURN to proceed to the next memory byte. To return to the VZBUG command loop, simply type "N".

Output memory – there are four different ways of accessing the VZ's memory with this command. They are:

"Output to printer in ASCII" - This prints out the contents of the locations selections on your printer in ASCII format. This is used to print out text created with the "I" command. The output is terminated by the HEX byte "00", which is the terminating character of the "I" command.

```
10 CLS
20 PRINT @200,"VZ MEMORY LOADER"
30 PRINT @ 232,"================="
40 PRINT"THE PROGRAME WILL AUTO EXECUTE  ON COMPLETION"
50 PRINT
60 FOR X=1 TO2000:NEXT X
70 CLS
80 N=1000
100 FOR A=-20480 TO -19386
110 READ A$
130 GOSUB 500
140 G=F*16
150 GOSUB 510
160 J=G+F
170 POKE A,J
175 M=M+1:IF M=16 PRINT"LINE";:M=0:N=N+10:PRINT N
180 NEXT A
200 POKE 30862,00:POKE 30863,176:M=USR(N)
210 STOP
500 Z$=LEFT$(A$,1)
505 GOTO 520
510 Z$=RIGHT$(A$,1)
520 E=ASC(Z$)
530 IF E>47 AND E<58 THEN F=E-48:RETURN
540 IF E>64 AND E<71 THEN F=E-55:RETURN
550 PRINT"ERROR"
560 PRINT"CHECK LISTING FOR INCORRECT     BYTE"
570 PRINT"CURRENT ADDRESS";A
580 PRINT"WRONG BYTE ";A$
590 STOP
1000 DATA 3E,0D,CD,3A,03,3E,2A,CD,3A,03,CD,F4,2E,FE,00,28
1010 DATA F9,FE,53,CA,A7,B1,FE,4C,CA,53,B2,FE,44,28,3A,FE
1020 DATA 49,CA,64,B2,FE,4F,CA,B2,B2,FE,47,28,1F,FE,43,28
```

Output to printer in HEX" - This prints ut the contents of selected locations on our printer in HEX code. Only 256 ytes are printed and then the program tops, displaying a "?" prompt on the creen. Press RETURN to print out the ext 256 bytes or "E" to return to the ZBUG loop.

Output to screen in ASCII" – Same as he first option, but the output is irected to the screen, not the printer.

Output to screen in HEX" – Same as he second option, but output is irected to the screen and blocks of 16 ytes are displayed at a time. To return o command loop, press "N".

hese options are selected with the fol-owing command line parameters:
elect **O** for output, then:

S/P	to select **S**creen or **P**rinter output, enter start address in HEX,
H/A	to select **H**EX or **A**SCII format.

.g. to display address B000 on the creen in HEX,
ype O,S,B000,H

ave on cassette – this command allows ou to save a block of memory to cas-ette. Type "S" followed by the name ou wish to allocate to the block (14 haracters maximum). CTRL "E" inishes the entry of the file name. You ust also enter the start and end addres-es of the block and then select either B" or "A", depending on whether you ant the block saved as a load-only or uto-execute routine. The "B" parame-er saves the program as load-only, whereas using the "A" parameter will create an auto-executing file. If you use the "A" parameter, be certain that the start address is a valid execute address, or the computer may lock up.

Getting VZBUG going

VZBUG is loaded as a BASIC program shown in the accompanying listing. I would strongly suggest that you enter the program in a number of stages, saving your work progressively. Take your time – maybe you should consider entering the data in two or three sittings, rather than a single eye-blurring, mind-boggling session.

Before you run the program initially, SAVE IT to cassette. As is always the case with machine-language-loading BASIC programs, a single error in entering the DATA statements can result in a computer lock-up, and the loss of all data in memory.

When the program is loaded it pokes into memory all the HEX code contained in the DATA statements at the end of the listing. It also checks to see if you have accidentally entered a non-HEX byte, and if so displays the address and contents of the incorrect byte. You can use this to locate and correct the error, by comparing the listings.

If you enter an incorrect but nevertheless valid HEX byte, the program will not trap it, and it may cause lock-up, so proceed slowly and carefully.

The program occupies addresses B000 to B447. It cannot be moved as it contains absolute addresses. I am prepared to supply reassembled programs at a different address, if you drop me a line at my address (see end of article), including a blank cassette and cheque/money order for $10.

Useful subroutines

Here are some additional useful subroutines I have implemented in VZBUG for users.

Executing hexadecimal address B151 instructs the computer to accept either two or four bytes from the keyboard, convert them to HEX and store them at HEX CFFA/B. The size of the input, two or four bytes, is determined by the check byte located at CFFF. If the check byte is HEX AB, then two characters will be accepted. Any other data will allow four bytes to be accepted.

Calling address B19F converts HEX to ASCII, and is used to display HEX data on the screen. The value to be converted is the one resident in the accumulator, after conversion is completed, the converted value is held in the accumulator.

Location B42F contains a routine to convert ASCII input from the keyboard into HEX. As with address B19F, the accumulator is used for both the original and converted values. The D and E registers are also used for this.

Besides these useful subroutines, there are many more contained in the VZ ROMs. Included with the assembler tape from Dick Smith Electronics is a full listing of the useful VZ subroutines.

Ready set go!

Now is the time to roll up your sleeves, polish your glasses, take the phone off the hook, and enter in the VZBUG listing. REMEMBER – take it easy, be careful, double and triple check, and **save before you run.** *HAPPY COMPUTING!*

Reg Batger
13 Hillview Rd,
Kellyville 2153 NSW

```
130 DATA CB,3F,CB,3F,CB,3F,CD,2F,B4,CD,3A,03,4F,3A,F2,CF
140 DATA E6,0F,CD,2F,B4,CD,3A,03,C9,3E,20,CD,3A,03,3E,00
150 DATA 32,FF,CF,CD,F4,2E,FE,00,28,F9,FE,0D,28,28,FE,4E
160 DATA CA,00,B0,3E,AB,32,FF,CF,CD,51,B1,3A,F6,CF,CD,9F
170 DATA B1,CB,27,CB,27,CB,27,CB,27,47,3A,F7,CF,CD,9F,B1
180 DATA B0,ED,5B,F0,CF,12,2A,F0,CF,23,22,F0,CF,CD,38,B1
190 DATA 3E,0D,CD,3A,03,C3,B2,B0,CD,50,34,CD,50,34,CD,50
200 DATA 34,CD,50,34,CD,50,34,CD,50,34,CD,50,34,CD,50,34
210 DATA C9,DD,21,F4,CF,DD,22,F4,CF,CD,F4,2E,FE,00,CA,59
220 DATA B1,11,36,B4,47,1A,B8,CA,72,B1,FE,FF,CA,59,B1,13
230 DATA 18,F3,CD,3A,03,DD,2A,F4,CF,DD,77,02,DD,23,DD,22
240 DATA F4,CF,CD,38,B1,3A,FF,CF,FE,AB,CA,96,B1,3A,F4,CF
250 DATA FE,F8,CB,C3,59,B1,3A,F4,CF,FE,F6,CB,C3,59,B1,DE
260 DATA 30,FE,0A,F8,DE,07,C9,CD,38,B1,3E,0D,CD,3A,03,3E
270 DATA 4E,CD,3A,03,3E,41,CD,3A,03,3E,4D,CD,3A,03,3E,45
280 DATA CD,3A,03,3E,2D,CD,3A,03,DD,21,D0,CF,3E,22,DD,77
290 DATA 00,DD,23,DD,22,E0,CF,CD,87,B2,3E,22,DD,77,00,3E
300 DATA 0D,CD,3A,03,CD,ED,B1,CD,FC,B1,C3,0B,B2,3E,53,CD
310 DATA 3A,03,CD,6B,B0,2A,FA,CF,22,A4,78,C9,3E,45,CD,3A
320 DATA 03,CD,6B,B0,2A,FA,CF,22,F9,78,C9,3E,42,CD,3A,03
330 DATA 3E,20,CD,3A,03,3E,41,CD,3A,03,3E,20,CD,3A,03,3E
340 DATA 3F,CD,3A,03,CD,F4,2E,FE,00,28,F9,FE,42,CA,45,B2
350 DATA FE,41,20,F0,3E,0D,CD,3A,03,21,D0,CF,0E,F1,F3,CD
030 DATA 16,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
040 DATA 00,00,00,00,00,18,C3,CD,C9,01,18,B4,CD,3A,03,CD
050 DATA 38,B1,CD,6B,B0,2A,FA,CF,E9,CD,3A,03,CD,38,B1,CD
060 DATA 6B,B0,2A,FA,CF,22,F0,CF,C3,B2,B0,CD,51,B1,3E,0D
070 DATA CD,3A,03,3A,F8,CF,CD,9F,B1,CB,27,CB,27,CB,27,CB
080 DATA 27,32,FA,CF,3A,F9,CF,CD,9F,B1,47,3A,FA,CF,80,32
090 DATA FA,CF,3A,F6,CF,CD,9F,B1,CB,27,CB,27,CB,27,CB,27
100 DATA 32,FD,CF,3A,F7,CF,CD,9F,B1,47,3A,FD,CF,80,32,FB
110 DATA CF,C9,2A,F0,CF,7C,CD,C9,B0,7D,CD,C9,B0,3E,20,CD
120 DATA 3A,03,7E,CD,C9,B0,C3,E9,B0,32,F2,CF,E6,F0,CB,3F
1360 DATA AC,34,C3,00,B0,3E,0D,CD,3A,03,21,D0,CF,CD,A9,34
1370 DATA C3,00,B0,3E,22,32,FA,CF,32,FB,CF,21,FA,CF,CD,5F
1380 DATA 36,C3,00,B0,3E,0D,CD,3A,03,CD,38,B1,CD,ED,B1,DD
1390 DATA 2A,A4,78,DD,22,E0,CF,CD,87,B2,3E,00,DD,77,00,3E
1400 DATA 0D,DD,77,01,C3,00,B0,3E,08,CD,3A,03,CD,F4,2E,FE
1410 DATA 00,CA,8C,B2,FE,87,C8,CD,3A,03,DD,2A,E0,CF,DD,77
1420 DATA 00,DD,23,DD,22,E0,CF,CD,38,B1,3E,A0,CD,3A,03,C3
1430 DATA 87,B2,CD,3A,03,3E,00,32,E2,CF,CD,38,B1,3E,0D,CD
1440 DATA 3A,03,3E,53,CD,3A,03,3E,2F,CD,3A,03,3E,50,CD,3A
1450 DATA 03,CD,F4,2E,FE,00,28,F9,FE,50,28,06,FE,53,28,05
1460 DATA 18,EF,32,E2,CF,3E,0D,CD,3A,03,CD,ED,B1,3E,48,CD
1470 DATA 3A,03,3E,2F,CD,3A,03,3E,41,CD,3A,03,CD,F4,2E,FE
1480 DATA 00,28,F9,FE,48,CA,25,B3,FE,41,CA,0F,B3,18,ED,3E
1490 DATA 0D,CD,3A,03,2A,A4,78,3A,E2,CF,FE,50,CA,0F,B4,CD
1500 DATA 75,2B,C3,00,B0,3E,0D,CD,3A,03,3A,E2,CF,FE,50,28
1510 DATA 51,3A,A5,78,CD,63,B3,3A,A4,78,CD,63,B3,3E,0D,CD
1520 DATA 3A,03,2A,A4,78,06,10,7E,CD,63,B3,23,10,F9,22,A4
1530 DATA 78,CD,F4,2E,FE,00,28,F9,FE,0D,28,D5,FE,4E,CA,00
1540 DATA B0,18,EE,32,F0,CF,E6,F0,CB,3F,CB,3F,CB,3F,CB,3F
1550 DATA CD,2F,B4,CD,3A,03,3A,F0,CF,E6,0F,CD,2F,B4,CD,3A
1560 DATA 03,C9,3E,10,32,E4,CF,3A,A5,78,4F,CD,C4,B3,3A,A4
1570 DATA 78,4F,CD,C4,B3,0E,20,CD,8D,05,3E,10,32,E8,CF,3A
1580 DATA E8,CF,FE,00,28,56,3D,32,E8,CF,2A,A4,78,7E,23,22
1590 DATA A4,78,CD,C4,B3,0E,20,CD,8D,05,18,E3,0E,0A,CD,8D
1600 DATA 05,C3,00,B0,32,F0,CF,E6,F0,CB,3F,CB,3F,CB,3F,CB
1610 DATA 3F,CD,2F,B4,4F,CD,8D,05,3A,F0,CF,E6,0F,CD,2F,B4
1620 DATA 4F,CD,8D,05,C9,3E,3F,CD,3A,03,CD,F4,2E,FE,00,28
1630 DATA F9,FE,0D,28,8D,FE,45,CA,00,B0,18,EE,0E,0A,CD,8D
1640 DATA 05,3A,E4,CF,3D,FE,00,28,DC,32,E4,CF,C3,87,B3,22
1650 DATA E6,CF,7E,FE,00,CA,00,B0,FE,0D,CA,27,B4,4F,CD,8D
1660 DATA 05,2A,E6,CF,23,18,E8,3E,0A,4F,CD,8D,05,18,F2,11
1670 DATA 36,B4,83,5F,1A,C9,30,31,32,33,34,35,36,37,38,39
1680 DATA 41,42,43,44,45,46,FF
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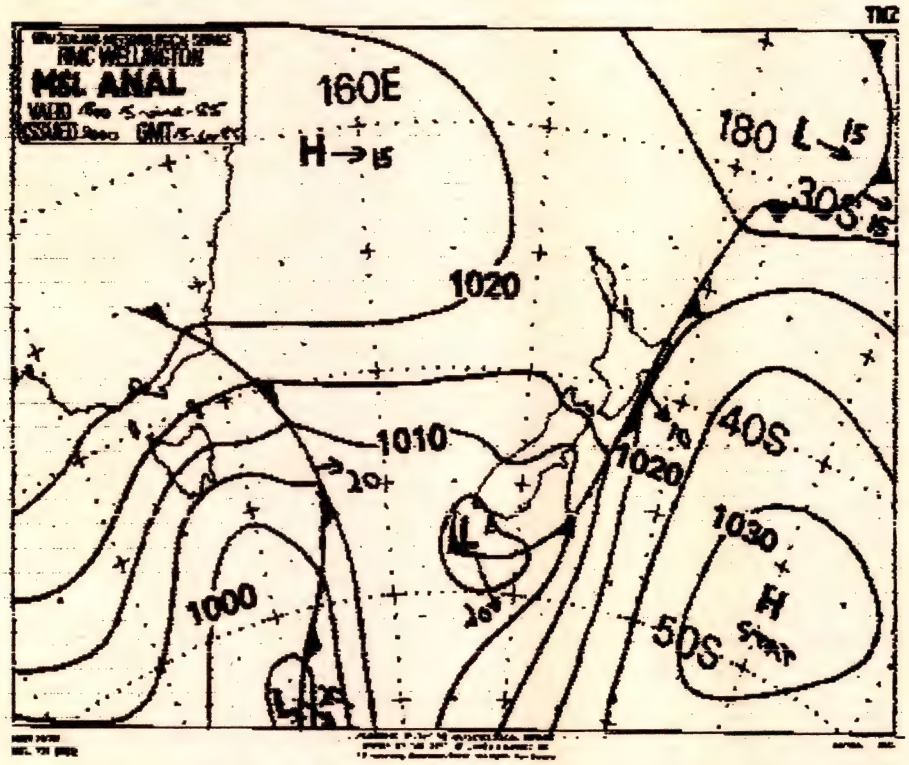


Weather maps for yachties

Dear Sir,

I purchased my first edition of Australian Electronics Monthly, July '88, and read with interest about weather fax and your *Listening Post* project, having heard about it for some time. As a yachtie, the thought of putting computers, printer and power supply aboard is abhorrent.

Could you design a weather fax project that would store the information received and just display on a TV when required? As most yachts have the receiving gear and TV aboard, this would be a much simpler way to go.

P. King,
Airlie Beach, Qld.

Congratulations on finding us!

Many yachties have satisfactorily installed Listening Post equipment on the yachts — computer printer and all! The way to go is to use a 12 V operated computer if you don't have 240 Vac aboard.

As for designing a weather fax unit to output on a TV receiver, yes, it's a possibility and we might look into that. However, there is one immediate drawback. You can only view the transmitted weather maps in real time. Without a printer to provide hard copy printout, you're at a severe disadvantage.

Storing the received data electronically is possible, but to store it in a random access memory is expensive as lots of it required. It could be stored on audio cassette tape, but it's inconvenient to use and slow in retrieval. A disk drive would be better. Best get the computer, I think!

Roger Harrison

A bouquet

Dear Roger,

Keep up the good work, especially computer interface projects (even modems!).

Kim Barnet,
Whyalla Norrie, SA.

Thanks for your kind words and your encouragement to keep going with modem projects. It just shows you, where on earth would Australia and we enthusiasts be without Telecom? And I bet you're one of the 14 M people who criticise this great Australian enterprise. There's ingratitude for you!

Snake oil, golden ears and solder

Dear Roger,

What are we going to do about the snake oil purveyors which infest the audio industry? If your average purchaser of noise making gear had a modicum of technological knowledge, then these charlatans would be consigned to a richly deserved oblivion with hoots of derision ringing in their ears.

But no. The punters are walking out of hi-fi shops weighed down with stuff like cables that would happily conduct your average lightning bolt, "directional" signal cables, vacuum tube amplifiers and other esoterica.

The snake oil salesmen have all got one phrase perfected. It goes "I don't know why it is, it just sounds better." It's just another form of the indefinite comparative so widely used in the advertising industry.

The punters seldom think to ask for any evidence to support these absurd assertions. Many of these can be subjected to good old A-B testing, though the Golden Ear push would probably start squabbling amongst themselves about the merits of the sounds of various relays.

What brought this on?

I was recently informed of a miraculous new solder. A snap at $6/m. *Six golly-o-goshes a metre!* Use this solder and your gear — you've guessed it — will sound better. I'm told you don't need a special soldering iron tip to use it, so I suppose the formulation is immune to contamination from your iron, pre-tinned components or whatever solder you're replacing. The silly buggers could have sold me that special tip for $30 or so! Throw in some "Miracle Sound Tip Cleanser and Solder Site Preparation" for, oh ... $15/g, and I'm away.

A bloke is going to be busy laboriously resoldering his gear. At least I'll be able to use some of that amazing low oxygen, directional, heavy duty gold-plated Litz sound conductor they're all raving about. I just wish I could get the latter in printed circuit board cladding. What's that? - PCBs are out? — point-to-point wiring sounds better?

So much to learn, so little time.

(Name supplied, withheld by request)

Shhh! Do you want to blow it? Haven't you heard of a solder-sucker before? With everything — like CD players, HDTV, S-VHS, 8 mm, PCs, and the ultimate, AEM — now invented and freely available for a few dollars, what else is left for us to invent and sell?

Tell your solder salesman to come back next year, perhaps April? Early. Like the first day of the month...

Harrowing hum problem

Dear Sir,

Referring to a hum problem discussed in the July '88 issue Letters column, I had a rather harrowing experience some time ago when I fitted one of those esoteric tonearms from England (Syrinx Leone LE1) to my turntable.

I tried all the things you described but in a totally disoriented manner. My turntable was a FONS International Mk 1. A much-lauded unit but in reality a heap of

shit (sorry about that). After going to incredible lengths to set the turntable up correctly (it had never been set up correctly since the day I purchased it) I was confronted with this infernal hum. It was simply because the new tonearm was totally isolated from the supporting framework earth of the turntable.

The only solution was to break into the earth lead which was moulded into the cable coming out of the tonearm base. I did this, and using a starpoint earth system eliminated the earth loop.

It sounds so easy, yet I found it was not. However, if I had followed your simple rules I would have fixed it quickly. The tonearm replaced was, by virtue of its design, earthed to the supporting bracket so the hum problem did not occur.

The electronics under the chassis were revolting with cables running around and around the unit, as if to create a magnetic field to add to the hum problem. I considered totally removing the power unit and replacing it with an ac plugpack but 6 V plugpacks were almost impossible to find unless you were willing to part with $60 or so. It never got to that as I eventually sold the unit to cut my losses and replaced it with a Thorens D-320 with its own tonearm and a Garrot P77 cartridge. That's satisfactory for me, although with CDs taking over I wonder about the sense of it all.

M. Taylor
Ringwood North, Vic.

Thanks for sharing your experience with us. You have our deepest sympathy; now you have added your name to the list of the famous who have enhanced AEM with contributions to "Letters", we trust that this is some small satisfaction for your tribulations.

Phone vandalism

Dear Sir,

Every year we hear the moaning of how much it costs to repair public telephone booths because of vandalism.

Since the majority of responsible adults now possess credit cards, why aren't they put to good use in the opening and closing of vandal-proof phone booths?

We could still go on using cash once we were inside, and if need be, a record could then be kept of the users of any particular unit that was abused.

P. Truscott,
Tullah, Tas.

Thank you for a positive suggestion. Too many people just moan without being constructive. Why not put your idea to Telecom? It is always interesting to see how far rigor mortis has set into any large body, and one way of assessing the degree of decrepitude is measuring the fight they put up against change.

Our only criticism is that your idea would put more of our hard-won money into the hands of that here-on-Earth black hole known as "Consolidated Revenue" via the insidious FID and BAD taxes on credit card transactions.

Product news error

Dear Sir,

The description of our Printed Circuit Oven for curing the resist on pc boards, published in *Professional Products News*, AEM March 1988, has suffered a typographical error. The oven will handle pc boards up to 250 x 200 mm, which is larger than the size stated.

N. Hoffman,
Sesame Electronics Pty Ltd.

Thank you for your letter. We do not apologise for the typographical error, as it was a cunning scheme on our part to mention your oven a second time in our pages. Just another example of AEM service and the ends we're prepared to go to for customers!

Query on the AEM6006 dc servo-feedback adapter.

Dear Sirs,

I have just completed assembling the AEM6000 Power Amp and I am very pleased to report that it is going beautifully; I am very happy with the whole set-up. In fact, I already have an Amcron PL4 amp, but I much prefer this 6000 and will be selling the Amcron in the near future.

However, I have one little problem which I have not been able to solve — that is the dc offset. I can adjust this alright, but it will not stabilise and tends to creep up or down all the time. I think it might have something to do with the temperature, as when the set has been turned on for about an hour, things seem to settle down a bit.

Hence my enquiry about the AEM6006 adapter. I have been trying various firms in Melbourne, Sydney and Adelaide to purchase two Printed Circuit Boards for the above — but have had no luck. Do you know where I can procure these?

B. Monaghan,
Bendigo, Vic.

The AEM6006 pc board is stocked by Eagle Electronics in Adelaide (08)271 2885. This dc servo adapter will certainly solve the problem.

If you haven't already done so, it's worth investing in the NTE461 dual-JFET for the input stage of the amp modules. They're available from Stewart Electronic Components in Melbourne (03)543 3733. The NTE461 is far superior in its thermal characteristics and matching to the 2SK146 included in kits from one supplier, the NTE461 markedly improving dc offset performance of the 6000.

Weather satellite receiver queries

Dear Roger,

I have a couple of queries on AEM 3520 project, the satellite receiver.

1) February '88, p.57: the photo of the board shows a resistor in parallel with RFC1 which is omitted in the layout diagram on page 55. Is it needed? What is ?

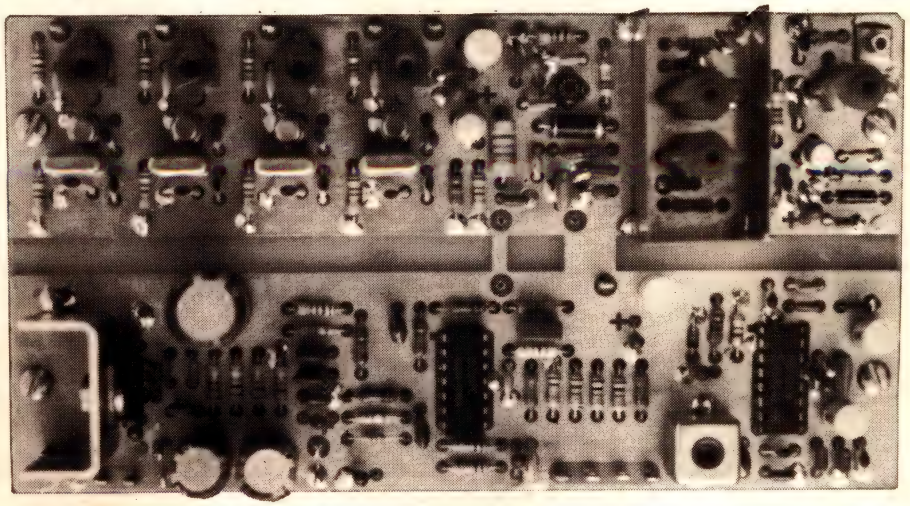
2) The C10/C15 combination occurs twice, in the photo and layout, but not in the page 50 circuit diagram. What is the missing pair like?

P. Mountford,
Perth, WA

On the first question, the resistor was found to be unnecessary and one lead was clipped on the prototype, which is quite visible on the page 57 photograph in the February issue.

Regarding the second question, yes — C10/C15 are repeated, same values. It's just some extra bypassing on the supply rail.

Roger Harrison



VHS vs 8 mm — Goldfinch challenged

What's to choose between the video formats? Our June feature on the subject, written by our correspondent, senior journalist Malcolm Goldfinch who's well experienced in this field, has been challenged by a reader as 'biased', among other things.

IN A LETTER much too long to print as sent, Mr Gary Pepper of Milperra, Sydney, says he regards Malcolm Goldfinch's article in the June AEM, *Video Camcorders: VHS vs 8 mm*, as biased.

"The great bulk of the article on camcorders is focussed on the non-issue of format compatibility," he wrote. Mr Pepper makes the point that Video 8 camcorders do not need connecting to any other VCR, but connect directly to the TV set, so format compatibility is a red herring. On running time capability, 8 mm runs three hours against VHS-C's one: cost, V8 $9/hr compared with VHS-C's $15/hr.

Further, Pepper wrote that the only way ½" VHS-C could be made to play longer, with the given cassette size, would be to make the tape thinner and thereby hastening the oncoming of tape stretch/breaking. He challenges the assertion that V8 is delicate and would prove unreliable as it aged, and writes that it was a blatantly wrong impression that Beta VCRs became sick and subject to mass breakdown.

"Sony has always been innovative and an engineering-focussed entity," Pepper said. *"Their products are usually one step ahead of the field in terms of design/specification but one gets the impression that they sometimes lack the marketing experience to pull the others with them.*

"It is unfortunate that once again they design a superior product in the case of V8, get it accepted by the others and then see JVC decide to confuse the issue by regurgitating a 10+ year old technology and reheat it for a second time."

Mr Pepper considered that quality and performance were the crux of the matter but Mr Goldfinch had compared the formats only scantily in these areas.

"I think the reason Mr Goldfinch chose to do so was that it certainly does not favour VHS-C in a head-to-head contest with V8."

He considered anyone who had compared an identical scene under identical lighting conditions shot with both formats could appreciate the superiority of V8, not just in terms of colour saturation but edge-to-edge clarity and audio reproduction.

Mr Pepper said the author had glossed over the quality merits and demerits of the formats by saying there were differences discernable under some conditions, particularly concerned with reproducing some colours: "Personal preference must be the arbiter here".

"Surely," Mr Pepper asks of this statement, *"The suggestion that some people would prefer their home movies to be of lesser quality is beyond the pale?"*

Editorial comment

In reply, let us set down a few background facts. Few video writers would have Malcolm Goldfinch's experience; ranging from making a horse opera in the hills behind Adelaide in 1934, to today's video camcorders. His cameraman in the first example used the Pathé 9.5 mm film: a format bigger and better than 8 mm with a single centre sprocket hole between frames.

At AEM we have often been able to advise you correctly, technically, before other magazines, about many new consumer products relying on some form of standard or format. We have learnt that most buyers do not choose the best, if there is a simpler alternative of similar quality and price available. We just aim to make you aware.

Mr Goldfinch opened his story by reminding readers that we covered seven pages in the November '85 and January '86 issues describing 8 mm in depth. He ended the 1985/6 articles with: *"Of all the many fine Sony products I have owned and used, the CCD-V8 must be the most brilliant. It represents a great step forward in videography. I would like to congratulate Sony for their leadership in establishing this exciting new format, as well as leading with such a high standard in their first camcorder."*

Space constrictions do not allow us to print Mr Goldfinch's reply to Mr Pepper in full, but salient points follow.

Goldfinch replies

I welcome Gary's comments as it tells me how short we "experts" have fallen in trying to explain the enormous complexities of video generally. Gary is obviously a quality fan. I hope he has a good quality TV to see the different quality from the various formats and makes of camcorder on the market. I have replayed many makes in some hundreds of homes and motel rooms. Just as in hi-fi sound, you could cart around a top quality amp and connect it to speakers in many homes and get amazingly different results, so too video varies with the TV. Usually I find that the badly adjusted average TV delivers less quality than the camcorder signal provides on a monitor; so what is all the argument about?

Because of my reputation I am asked by many friends and acquaintances about every appliance before people buy. When I ask, "Is the highest quality your chief concern? Or practicality?", the answer is almost invariably "Practicality!"

The standard of quality in all video units I have tested in recent years is so good that it really takes a test laboratory to show comparisons.

In trying to help the average video buyer, I will consider more the convenience than quality because quality is not really a problem to most home video users. Convenience varies greatly, and I rate compatibility and cost saving the highest priority; no apologies, Gary.

I stick by my personal colour tastes remarks as each camcorder, of even one make, can vary. Remember, in photography the fans argue and fight over which film has the best colour balance: Kodak, Fuji, Agfa. There were people who would not use Kodachrome, only Ektachrome. Which is the best? They are all very good.

The statement that video and camcorders do not require the user to make any kind of connection to any other VCR does not appear in my story. Referring to the VHS-C adaptor, I said, "Of course 8 mm camcorders have no need for such an accessory." There is no way an adaptor could make an 8 mm tape usable in a ½" tape VCR. Referring to all camcorders I did say they came with "..a TV converter and connectors." It appears there is a general lack of understanding about the basics.

All formats of camcorder that can replay with TV-type viewfinder (EVF — electronic viewfinder) come with a small RF modulator box, and standard aerial connector cord for the modern TV set. This connects the camcorder and makes it into a TV station which is then tuned in by the TV. Unless a V8 camcorder owner has a V8 format VCR the RF way is the only way the video on his V8 cassettes can be played back.

For those who have a VHS camcorder with playback, they can also TV playback with an adaptor, but they also have the option of leaving the camcorder in its carrying bag and just slipping the cassette into their cassette adaptor, then into the VHS VCR and playing it in the normal way as both camcorder and VCR use ½" videotape. If you have a V8 camcorder without the replay viewfinder, then to see your video you will have to buy a V8 VCR just for this purpose. If you have a similar non-replay camcorder in VHS and a VHS VCR, you can slip the video you have taken into the adaptor and play it back in the VCR.

With VHS-C for playback, there is no removing wires and connecting with an adaptor required. This is what I mean by convenience for a VHS owner, no new VCR to buy and instant replay on the existing VCR!

Turning now to V8 tape formulation, this is more advanced than in current VHS-C tapes. It has to be, to allow an 8 mm tape to have any chance of equalling the ½" (12.65 mm) tape with the information it has to store. As I suggested, when V8 was introduced, watch out for VHS when the new metal particle tape process is introduced in the ½" tapes. This has now happened in Super VHS and looks like wiping out the margin between home video and professional quality. (See last month's AEM.)

The point Gary makes about relative costs is right if you are just buying cassettes, wrong if you are a normal home movie maker. The 8 mm film buff spliced his three-minute reels together into bigger reels, each to a specific subject.

The video buffs I know, either ex-8 mm film enthusiasts or entirely new to home movies, follow a common pattern, using different cassettes for different activities; family scenes; golf swings; Charlie's football matches; our visit to Expo. From these he will perhaps dub if he is a VCR owner a "Family Album" of the best video moments on all these other cassettes. I have many such going back to my first video days in 1979. They are mostly 3 hr cassettes with usually less than an hour on them.

Consider that the average home video maker produces at the most only a few hours a year that are worth keeping. He is certainly not going to put all this on a three hour tape and have the nightmare of finding some one minute shot in the middle, or was it near the end? Nor does anyone want to lend to some demanding family member the last two years of video shots on one 3 hr tape which may never return.

I now have some 35 VHS-C cassettes shot all over the world. In seconds I can have any scene up and running. Most are full, or nearly. While travelling I have bought VHS-C at $A7-8. Three or four may do a month-long trip. If I loose one or accidentally record over it there's no great tragedy. I do not put all my eggs in one basket. Again, it is convenience that is the critical factor. The only time a 3 or 4 hour tape is required is when recording a week-end of TV programmes. Camcorders do not do this.

I'm glad you mentioned tape thickness relative to VHS-C duration, Gary, as I tried to avoid being negative about the V8 format. The answer is yes, I agree, there is every likelihood that there would be a much higher rate of tape failure with a thinner tape; much more so if the tape width is reduced by 37 per cent. The V8 format reduces both the tape thickness and width. There is no demand from home movie makers for longer VHS-C cassettes and no plans to depart from the full VHS formats, but you have almost answered your next point, that V8 would prove unreliable after ageing sets in.

The one reason why the compact audio cassette has been so acceptable world wide is because it is play/recorded inside the shell. Even then we are aware of old cassettes twisting, snagging, breaking tape, and spewing out fisherman's tangle of your most precious recordings. Refer to the table here.

The width is 3.81 mm, but the V8, Beta/VHS formats which require that a finger-roller plucks the tape out of the cassette and winds it around the scanning head with sharp turns. In VHS this wrapping is done equally from either side with less convolutions. The tape thickness selected to withstand this type of treatment in Beta/VHS is still 19.5 µm. No one has suggested that this is over-engineering, so the reduced width and thickness in V8 of 13.0 and 10.0 suggests to me that it might be under-engineered. The physical properties of the video tape have been fairly consistent for some years.

Fancy metal coatings of magnetic material have nothing to do with mechanical strength. As well, the width of the head scan in V8 is an amazing 5.3 microns compared with Beta 10.2 and VHS(all) 10.07. To keep V8 heads properly in register with such fine tracks on replay when the mechanical parts begin to wear will be many more times difficult than with the wide tracks of ½" VHS/Beta tape. For these reasons I predict more reliability with ageing for the full format tape. If it will allow the small size and weight camcorder I want, and VHS-C will do just this, then it is my choice for a long reliable life.

In law, many judgements are based on precedents. As photography and video are both methods of imaging, of photography it is valid to use the precedence of camera film technology. In the 60's the pocket camera standard of 35 mm was challenged by Kodak with their new C110 format. The hype for this super fine-grain minifilm, which was to supersede 35 mm and make cameras smaller and lighter, was overwhelming. Every maker offered 110 mini-cameras.

Today, the power of the consumer has dictated a return to the slightly larger 35 mm film camera; a bit bigger, but better quality. The 110 format was briefly the way to go, now it is just a residue product. The ill-fated Kodak disc camera promoted as a lady's handbag item has gone the same way. The consumer was asked to abandon the robust and proved 35 mm format with 864 mm² of image for one of only 221 mm² (25.6 per cent) in the 110 format. It was not convenient.

It gives me no pleasure to recall these marketing failures. Both the makers who promoted them and their customers have suffered losses. At the time, almost every writer and consumer magazine went along with the hype. If only a few had raised the logical disadvantages which became evident later in the use of the products, the pain could have been minimised.

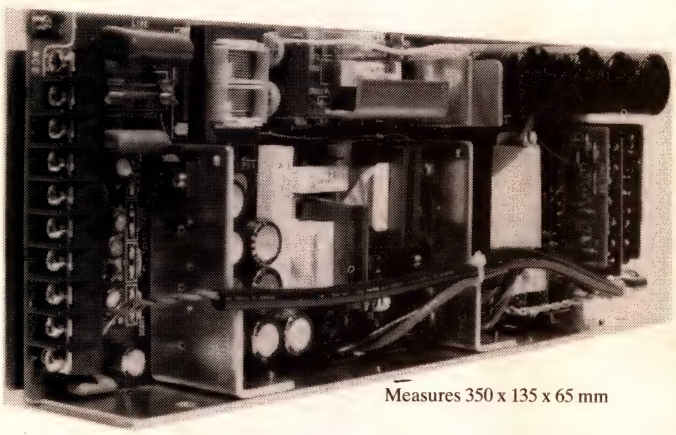
Thank you Gary Pepper for the stimulation of your provocative criticism. It has shown that these matters should be considered and the relevant facts presented. Consumer choice is only as good as the information available.

You suggested that AEM should send me to Expo, but that has already been achieved and when you read my story on HDTV and Super TV in AEM soon you will see my "re-education" has already taken place. With Super VHS soon available in VHS-C you will then have no problem determining which format has the best quality.

Malcolm Goldfinch

CASSETTE FORMAT	TAPE WIDTH, mm	TAPE THICKNESS	DIFFERENCE
Compact Cassette	3.81	12.5	100 %
VHS, VHS-C, Beta	12.65	19.5	100 %
Video 8 mm	8.00	Standard Play 13.0	-38.4 %
Video 8 mm	8.00	Long Play 10.0	-51.3 %

. . . . . PSST!



Measures 350 x 135 x 65 mm

National Matsushita Electric

Want some juice . . . . ?

They're back! Remember those great **National** power supplies we advertised at the end of last year? Well, during a Spring clean this Autumn, A.J. Distributors found another batch, hiding at the back of a shelf in their store-room. So, if you missed out last time, or maybe want another one or more, ***HERE'S YOUR CHANCE!***

It makes a great computer power supply or a general bench supply (but you must run it with the minimum load of 3 A on output A).

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- Total power output of 150 watts.
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- Conforms to standards; UL114, 478, CSAC22.2 NO.143, NO.154, IEC380 (class 1), BS5850 (class 1) and VDE0806 (class 1).
- 50 kHz Operation.
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Output A: + 5 V, 3-15 A
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Output C: + 12 V, 0.4-1.5 A*
Output D: –12 V, 0.4-1.5 A*
Output E: –5 V, 0-1 A

* If a lower voltage is required on outputs B, C or D, provision is made on the PCB for a TO220, 78xx series regulator to be inserted.

All that for just **$111** (inc. sales tax) !

$95 (excl. sales tax)

A.J. Distributors has made this offer available exclusively to readers of Australian Electronics Monthly, the magazine is acting as a clearing house for orders. Orders are collated and despatched weekly.

If you want to inspect a sample, call into our offices at Balmain during business hours, but PLEASE phone first on 555 1677.

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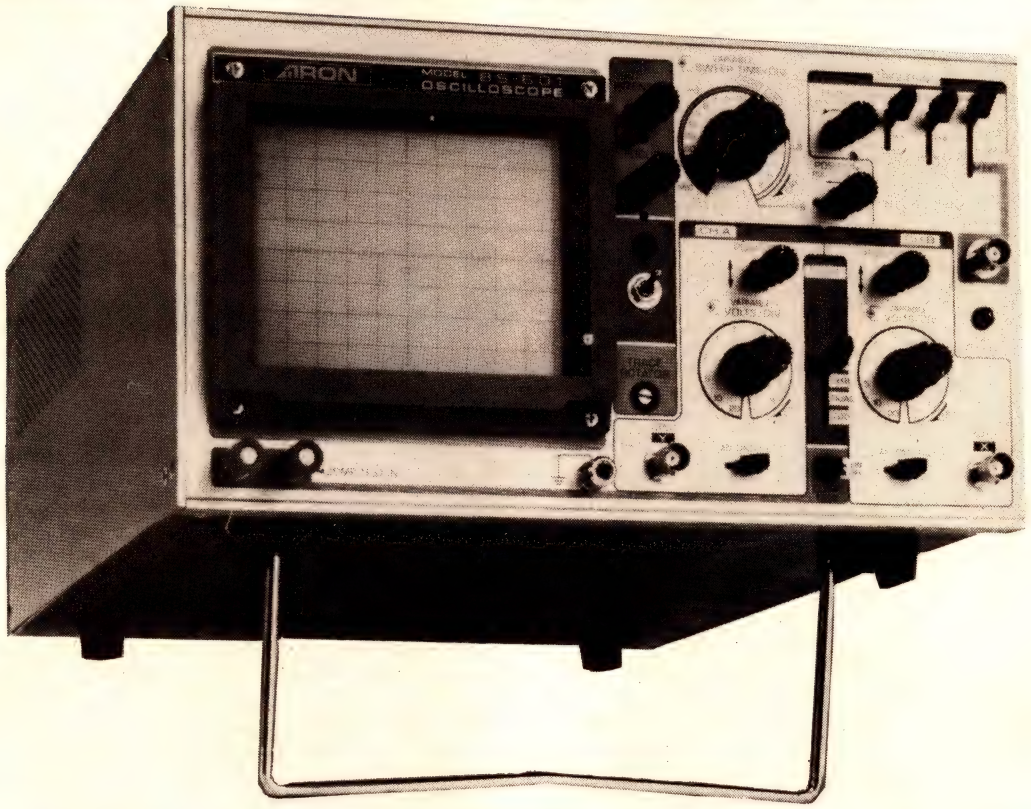
Servicemen – Enthusiasts. COP THIS!



You could win an Aaron dual-trace 20 MHz CRO with built-in component tester, model BS-601. Nearly $900 value!

1) Where does the 'cathode dark space', or 'Crooke's dark space', appear in a cathode ray tube?

. . . . . .

2) In 1967 Elmeasco Instruments commenced operations in small offices in a well-known Sydney suburb. Which suburb was this?

. . . . . .

3) What shape would you expect to be displayed on the Aaron BS-601 oscilloscope if a capacitor were being tested using the component tester?

. . . . . .

How would you put the Aaron dual-trace 20 MHz CRO to good use? Tell us in 25 words or less.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

Here is a golden opportunity to own this versatile general purpose 20 MHz CRO from Aaron. It boasts a large 150 mm flat-faced high brightness CRT with internal graticule. The two inputs may be displayed separately, added or inverted. The trigger coupling mechanism features TV Sync Vertical and Horizontal Sync Separator Circuitry, which allows any portion of complex TV video waveforms to be synchronised and expanded for viewing.

Vertical sensitivity can be set between 5 mV – 20 V per division, in convenient 1-2-5 steps. Horizontal calibration is between 0.2 μs – 0.5 seconds per division, with the sweep magnifier providing 5x enlargement for clearer viewing of complex waveforms.

The in-built component tester quickly and easily displays graphically the characteristics and values of components such as resistors, diodes, capacitors, individual transistor junctions etc., unambiguously showing where any fault may lie. Semiconductors can be matched for similar characteristics, and suspect components can be tested without the need to apply power to the circuit.

Prize kindly donated by Elmeasco Instruments Pty Ltd.

Snowy microwaves solve lightning problems

Communications with Cabramurra in the Snowy Mountains are now lightning-proof thanks to a new microwave link. Lightning damage to the old copper cable link frequently disrupted communications, and often damaged the Hydro-Electric Authority's new digital telephone exchange at Cabramurra despite protective precautions for the solid-state circuitry.

Now Mitec of Brisbane has adapted its miniature microwave transceivers to a digital link capable of carrying data at 2M bits per second.

Mitec was established as an offshoot of Queenslansd's University's research into microwave communications. The company now produces transmitters and receivers little more than a cigarette package in size.

Mitec claims the new product has a significant price advantage in the communications market in Australia and overseas for 30 channel PCM systems and is also suitable for the new ISDN primary rate services.

The RF connection

A complete range of RF coaxial adapters, connectors, attenuators, signal samplers, RF loads, terminations and static and lightning arrestors aimed at the communications industry is available from Obiat.

Included are UHF, mini UHF, N, BNC, TNC, and the F plugs, jacks, connectors and adapters for various coax cables.

Adapter kits are for service departments and laboratories and let staff interface various connectors quickly.

For a catalogue and more information, contact **Obiat, 129 Queen St, Beaconsfield 2014 NSW. (02)698 9170.**

Sizzle revives Tamworth ARC

With the savoury sizzle of a BBQ, the re-formed Tamworth Radio Club plans a field day at the Tamworth Racecourse, Jewry St, Tamworth, from 9 am to 5 pm on Sunday, October 30.

Demonstrations of new equipment will be one of the features of the day, club spokesman Trent Simpson told AEM.

"At present we are trying to raise funds so we can promote the communication network in the north-west of NSW," he said.

"The field day is the start of the re-forming of the Tamworth Radio Club."

CQ, product sellers!

Chris Ayres, VK2YUS, has been given a sked at Dick Smith Electronics as specialist product buyer in charge of amateur and related communications products.

The managing director, Mr Jeff Grover, said that in creating the specialist position to service the ham market, DSE was acting on feedback from customers.

"Many customers believed that we were getting out of amateur radio, or at least winding it down," Mr Grover said.

"This is, of course, completely the opposite of our intention.

"However, we needed someone who knew the amateur market intimately who could guide us in our decisions.

"Chris Ayres has that knowledge, is a very keen and active amateur and will be able to help DSE once again become the leading supplier of amateur radio equipment in Australia."

Before Ayres moved up the DSE band to higher frequencies, he was manager of the North Ryde shop. He has managed several stores and operated as amateur radio specialist in others, since he keyed into DSE eight years ago.

Kerry Nufer is pictured here with the Mitec microwave unit on the right. Cabramurra township can be seen in the background.

Screw them up

For all those who can never get their screw threads to mate, the Transradio *Universal Between Series Adapter Kit* is an attache style case with 30 fittings — 24 connectors and six interseries — so you can make any adapter immediately.

The fittings screw together. This provides the desired combination, without aids, or soldering or crimping.

The screw bodies are silver-plated, the centre contacts are gold-plated and the FM contacts are phosphor bronze.

To get a kit of screw body adapters, contact **Multi-Contact, 53-55 Whiting St, Artarmon, 2064 NSW. (02)438 3600.**

Cellular antenna

A low profile antenna, in either 3 or 5 dB gain versions, uses a unique mounting technology that couples it to the coaxial cable through window glass, providing a secure, fast, no-holes installation.

The Oz-Glass antenna features

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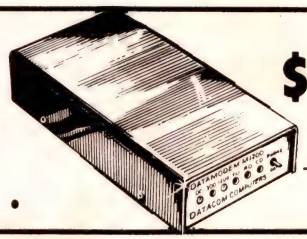

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a coupling design that reduces visual impact, fits between defroster grid wires and virtually eliminates any potential defroster interference, the manufacturers claim.

Because of the antenna's low profile, the loud whistle normally associated with this kind of radiator is substantially reduced.

Vicom, which is marketing the antenna, directs inquiries to its branch offices in Australia and New Zealand. Or contact their Victorian head office on **(03)690 9399.**

Computerised logging for amateurs

Now you don't have to be able to write to log your contacts, if you use the latest Tricky Dicky trickery and your PC/clone.

Dick Smith Electronics has introduced an IBM PC compatible program, the Logmaster, cat. X-9702, which allows you to enter and track all contacts using a simple menu-driven screen.

Once entered, there are valuable functions available: print your QSL cards, sort and list your contacts by frequency (all stations you have contacted on frequency), or contact station (all contacts by frequency).

Contest scoring is helped by handling duplicate logging.

QSO DSE at **P.O. Box 321, North Ryde, NSW 2113. (02)888 3200.**

Hand-held marine VHF

One-button access to the channel 16 emergency net is an important feature of Icom's handheld 5 W VHF marine transceiver.

The IC-M11 has splash-resistant, dust-proof rubber seals on all casings and switches, strong front and rear metal frames and an operational temperature range equally able cope with the tropics to the Antarctic.

It is programmed with all possible VHF marine channels, and the 24 user-programmable memories can store preferred frequencies at the touch of a button, or clear and rewrite memories instantly.

The *dual-watch* and *tri-watch* functions monitors two or three channels simultaneously. The transceiver also features multiple scan modes: dial scan for all-channel monitoring; and memory scan to monitor only the 24 user menmories, plus dual-and tri-watches.

Call **Icom, 7 Duke St, Windsor, 3181 Vic. (008)33 8915.**

Transceiver measurements

A portable test set, the Stabilock 4031, has features for reliable measurements in the field or laboratory, the makers claim.

You can make AM or FM system measurements over a frequency range of 400 kHz to 1000 MHz. The unit also functions as a spectrum analyser and digital oscilloscope.

Duplex operation is an option. The RF input of less than 2 µV allows for remote measurements and use as a monitoring receiver. It can be powered from the mains or 32 Vdc.

Further details from **Tech-Sales, 12 Maroondah Hwy, Ringwood, 3134 Vic. (03)879 2266.**

Subminiature coax connectors

Subminiature snap-on coax connectors, the Radiall SMZ 75 Ω range, dc to 6 GHz, have been developed to IEC46 D standards.

They are for civil and military telecommunications, aeronautics and mobile communication systems applications. The plugs are female and the jacks have male contacts.

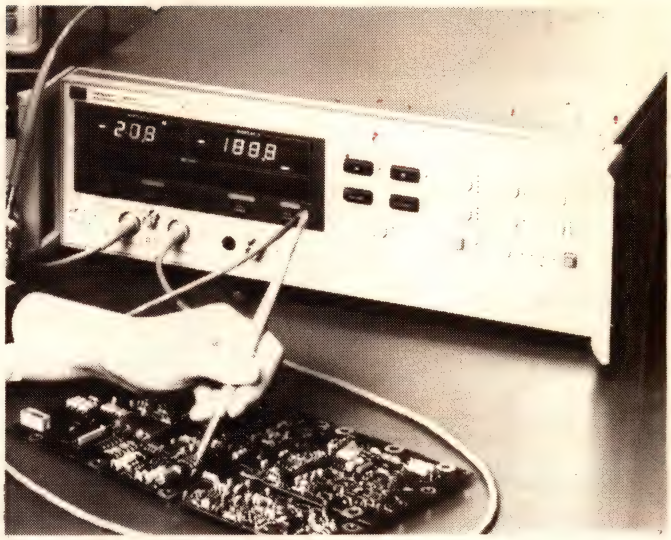
More from **A. P. Imports, 61 Aero Rd, Ingleburn, 2565 NSW. (02)829 1555.**

RF spectrum analyser

A portable, general-purpose RF spectrunm analyser covering 10 kHz to 1.5 GHz has been released by Hewlett-Packard.

Known as the 8590A, it has selectable resolution bandwidths of 1 kHz to 3 MHz.

Operation is simplified by internal parameters such as



bandwidth and attenuation adjusting automatically. Percentage AM, 3 dB and 6 dB bandwidths are calculated aurtomatically.

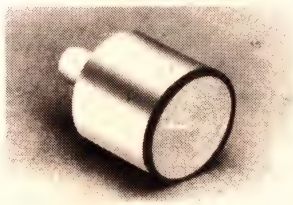
An built-in unit Fast Fourier Transformation function permits high resolution measurements of demodulated sidebands such as AC hum.

There are more details, obtainable from **Tech-Rentals, PO Box 621, Ringwood, 3134 Vic. (03)879 2266.**

Microwave antenna

A cavity-backed Archimedian spiral antenna offers the microwave system designer broadband pperformance in a small, low-cost package.

It is designed for flush-mounted airborne applications, including surveillance, telemetry, and DF command and control.



These circularly-polarised, planar spiral antennas operate from 8 to 18 GHz, and feature VSWR of less than 1.6 across the band, according to the manufacturer.

For more information: **Benmar, GPO box 4048, Sydney, 2001 NSW. (02)233 7939.**

RF vector voltmeter

A vector voltmeter for sensitive RF voltage and phase measurements offers a low-priced solution for instruments in the 100 kHZ to 1 GHz range, or 300 kHz to 2 GHz.

The Hewlett-Packard 8508A has applications that include: use as an RF millivoltmeter for measuring low-level signals; in-circuit probe to align gain and phase response or for troubleshooting; charaterise circuit S, Y or Z parameters; and use as a building block in ATE systems.

With either input channel, the unit can read voltage or power directly. By connecting the second input elsewhere in the circuit under test, gain (or loss) and phase difference can be measured.

The narrowband tuned receiver can measure signals as low as 10 µV (-87 dBm). Dynamic range is 90 dB. Hewlett-Packard is at **31-41 Joseph St, Blackburn, 3130 Vic. (03)895 2895.**

SSB crystal filter

A 10.7 MHz monolithic crystal filter for SSB applications, the locally-designed CY920, is a reply to the high cost of imported filters.

The monolithic two-pole filter elements allow the unit to work in a package 15 x 18.5 x 12 mm, intended for pc board mounting.

More details can be supplied by **Stewart Electronics, PO Box 281, Oakleigh, 3166 Vic. (03)543 3733.**

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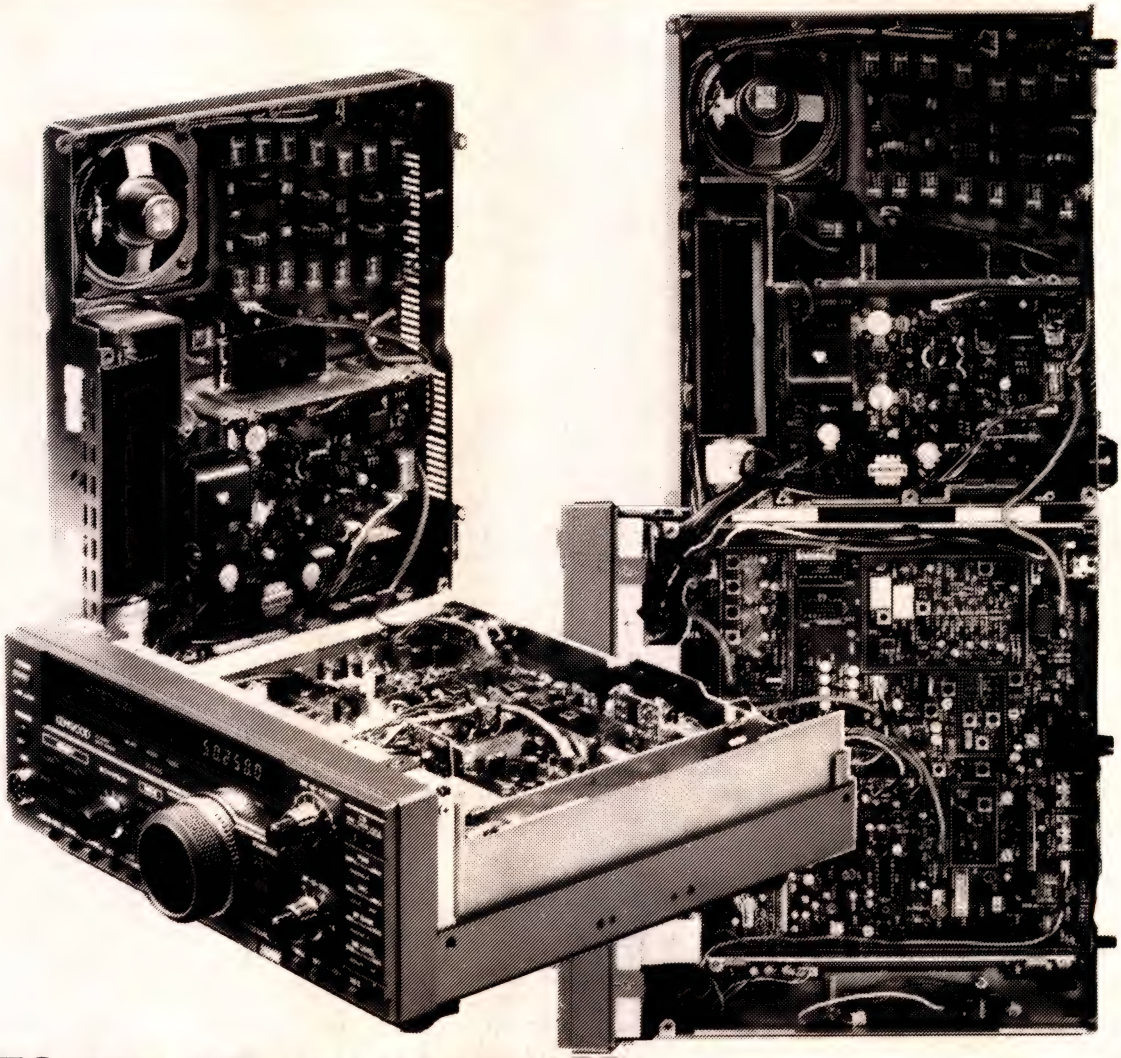

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Do-it-yourself HF propagation predictions using a PC

Part 1

Leo McNamara

With the Sunspot number rising steeply by the month, interest in the high frequency bands is increasing apace. For decades, HF radio propagation predictions were the province of government agencies and professional bodies with the appropriate resources. But personal computers and some slick programming are changing all that. With the programs to be described in these two articles, you can do your own predictions.

ONE OF the exciting challenges of being a radio amateur or shortwave listener operating on the HF bands is to 'get through' when you shouldn't. Getting through when conditions are wide open is no challenge at all! But how can we know that conditions on a circuit are expected to be impossible, marginal or perfect?

One thing we can do is to take advantage of HF propagation predictions (*AEM*, May 1986) supplied by some official organisation. But this takes all the fun out of it for some of us who would rather do it all ourselves.

The program MINIMUF (*QST* December, 1982, pp36-38) has provided, for nearly a decade now, a good feel for what we can expect in the way of frequency support on a given circuit, and has done this in a simple and fast fashion. MINIMUF is not, however, without its detractors who find that it sometimes produces unacceptably large errors in its predictions of the maximum usable frequency (MUF).

Figure 1, for example, shows a comparison made by the Australian Ionospheric Prediction Service (IPS Radio & Space Services) between the MUF for a 3000 km circuit centred on Canberra (Australia), as determined by MINIMUF and by the IPS prediction method. The spread in errors of the IPS predictions is only about one-quarter of the spread in the MINIMUF predictions.

The situation is similar for a North American station (Boulder, Colorado), as illustrated in Figure 2.

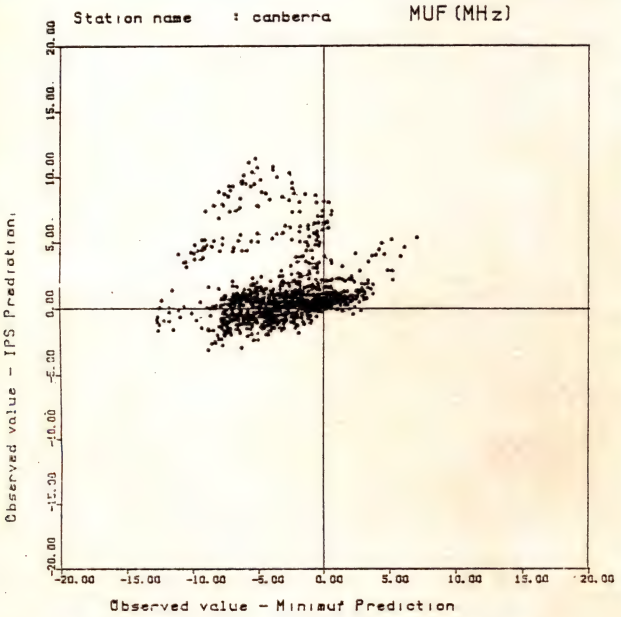


Figure 1. A comparison, made by the Australian IPS Radio & Space Services, between the MUF for a 3000 km circuit centred on Canberra (Australia) as determined by MINIMUF and by the IPS prediction method. The spread in errors of the IPS predictions is only about one-quarter of the spread in the MINIMUF predictions. (From IPS Technical Report IPS-TR-85-07).

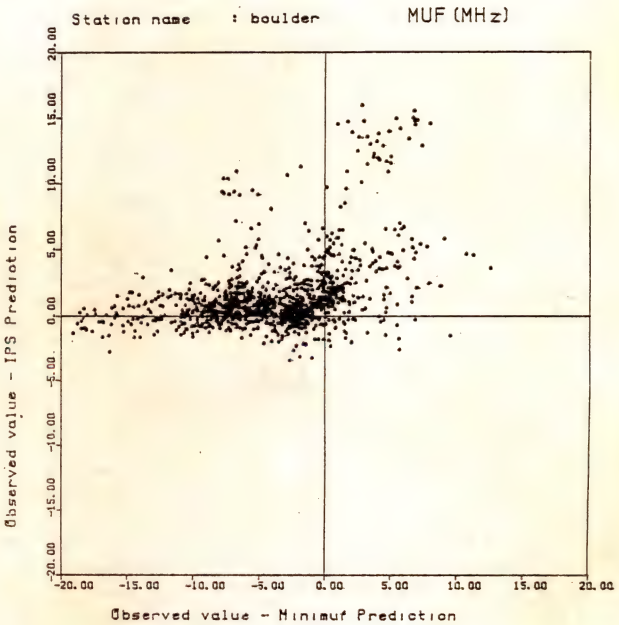


Figure 2. Another comparison between MUF predictions and IPS predictions, this time for a path centred on Boulder, Colorado (USA). (Also from IPS Technical Report IPS-TR-85-07).

Later versions of MINIMUF doubtless have smaller errors, but these do not seem to be available to the amateur community.

Two programs

This is the first of two articles describing briefly two programs developed by Thomas Damboldt and P. Suessmann of the West German Post Office. Because the Germans refer to their post office as *Forschungsinstitut der DBP beim FTZ*, you know now where the FTZ in the program names comes from!

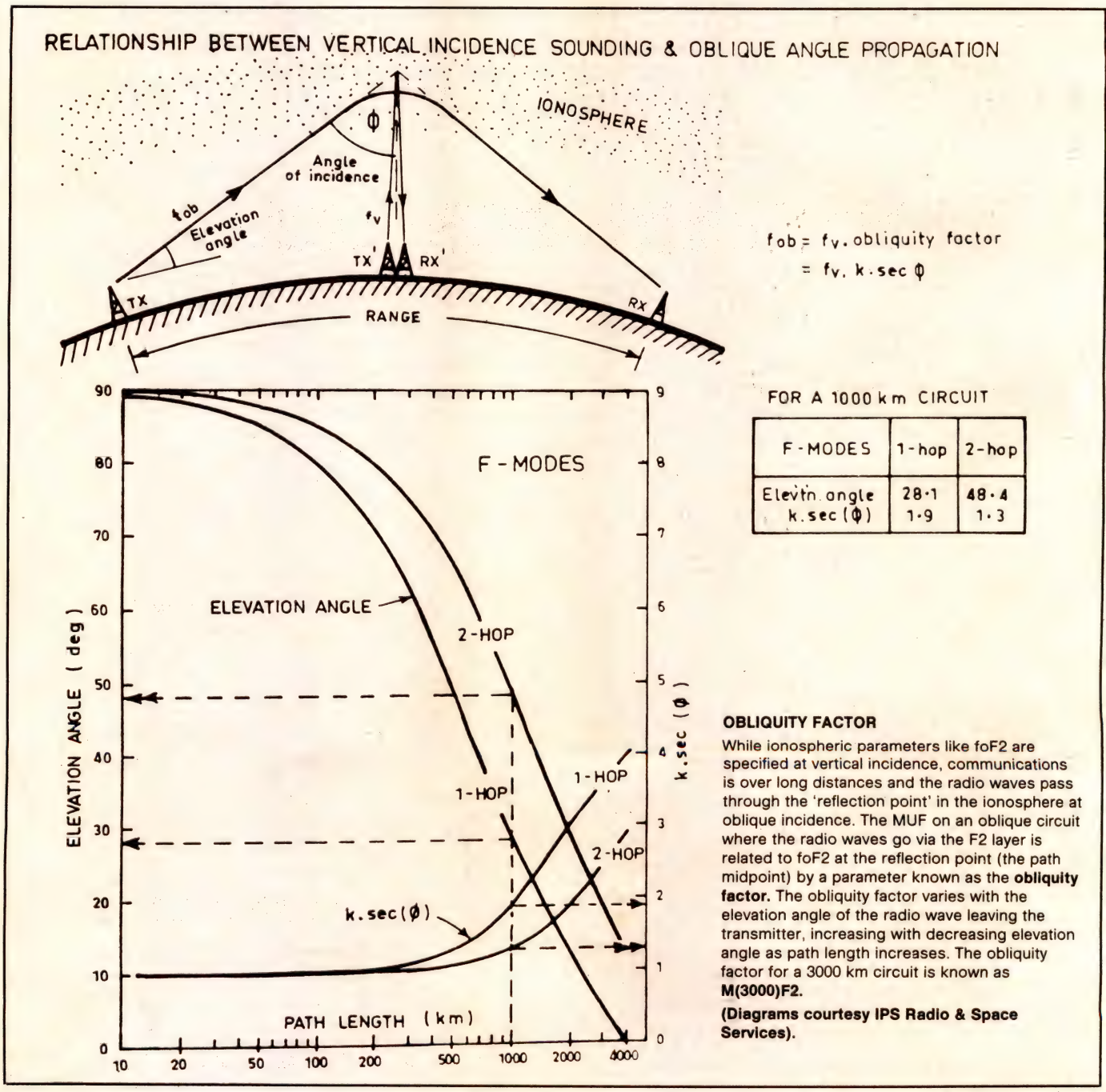
Both are written in BASIC, and both are memory misers. The first program we shall describe, FTZMUF2, requires 8.7K bytes, and calculates the MUF for a 4000 km circuit centred on a specified location. FTZMUF2 is therefore broadly similar to MINIMUF in this respect.

The second article will describe the more complicated program MINIFTZ4, which calculates the field strength as a function of frequency, as well as the MUF for any specified circuit.

These two programs should give the amateur or shortwave listener with a PC, or access to one, a very good knowledge of what to expect on any frequency and circuit at any time. You will still need to know the effective Sunspot number (*AEM*, March 1986), which can be determined from a graph or chart to be published as a regular service by AEM. Be prepared to take some care in applying the results generated by FTZ, since they are based on some simplifying assumptions which may not always be valid. But this will become clear later, after you've learned a little more about the programs and the background to how the predictions are done.

How the predictions are done

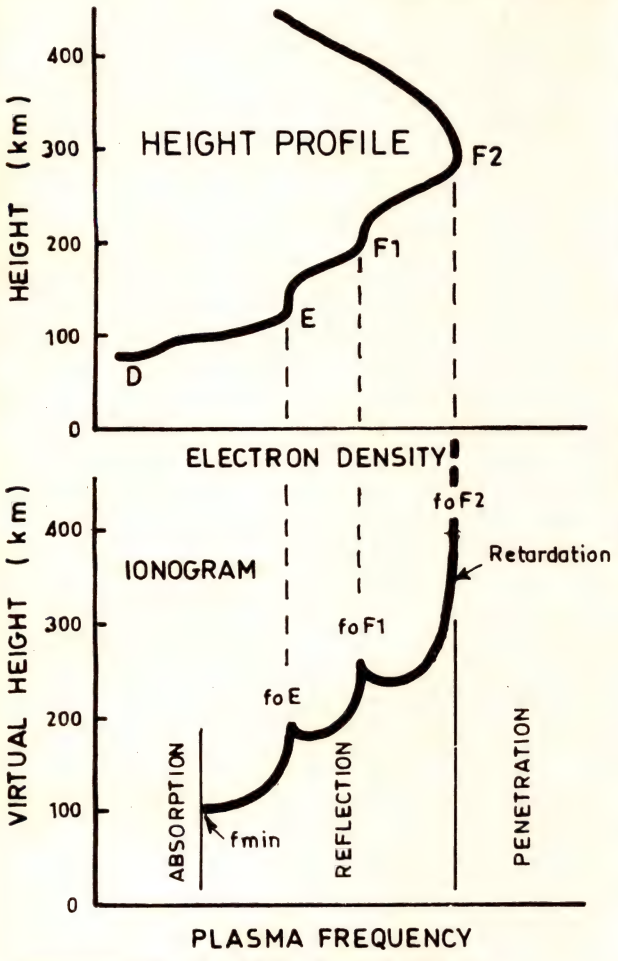
The problem of predicting the MUF is essentially one of using world-wide maps of the *critical frequency* of the F2 layer, foF2, and the *obliquity factor*, M(3000)F2, to determine foF2 and M(3000)F2 at the circuit midpoint, and then working out the value of the MUF for a 3000 km circuit.



OBLIQUITY FACTOR

While ionospheric parameters like foF2 are specified at vertical incidence, communications is over long distances and the radio waves pass through the 'reflection point' in the ionosphere at oblique incidence. The MUF on an oblique circuit where the radio waves go via the F2 layer is related to foF2 at the reflection point (the path midpoint) by a parameter known as the **obliquity factor.** The obliquity factor varies with the elevation angle of the radio wave leaving the transmitter, increasing with decreasing elevation angle as path length increases. The obliquity factor for a 3000 km circuit is known as **M(3000)F2.**

(Diagrams courtesy IPS Radio & Space Services).



(Diagrams courtesy IPS Radio & Space Services).

$$MUF(3000) = foF2 \times M(3000)F2.$$

In general, for circuits corresponding to a circuit length D, the MUF is

$$MUF(D) = foF2 \times M(D)F2,$$

where M(D)F2 is derived from M(3000)F2 using rather messy geometrical considerations.

For the particular case of a 4000 km circuit,

$$MUF(4000) = 1.1 \times foF2 \times M(3000)F2.$$

The internationally accepted maps of foF2 and M(3000)F2 are in the CCIR *Atlas of Ionospheric Characteristics* (Report 340 of the Consultative Committee for International Radio).

The atlas has 988 numerical coefficients for foF2 and 441 coefficients for M(3000)F2 for each month and for two levels of solar activity (or "epochs") — low, with Sunspot number of 0, and high, with Sunspot number of 100. The storage requirement is:

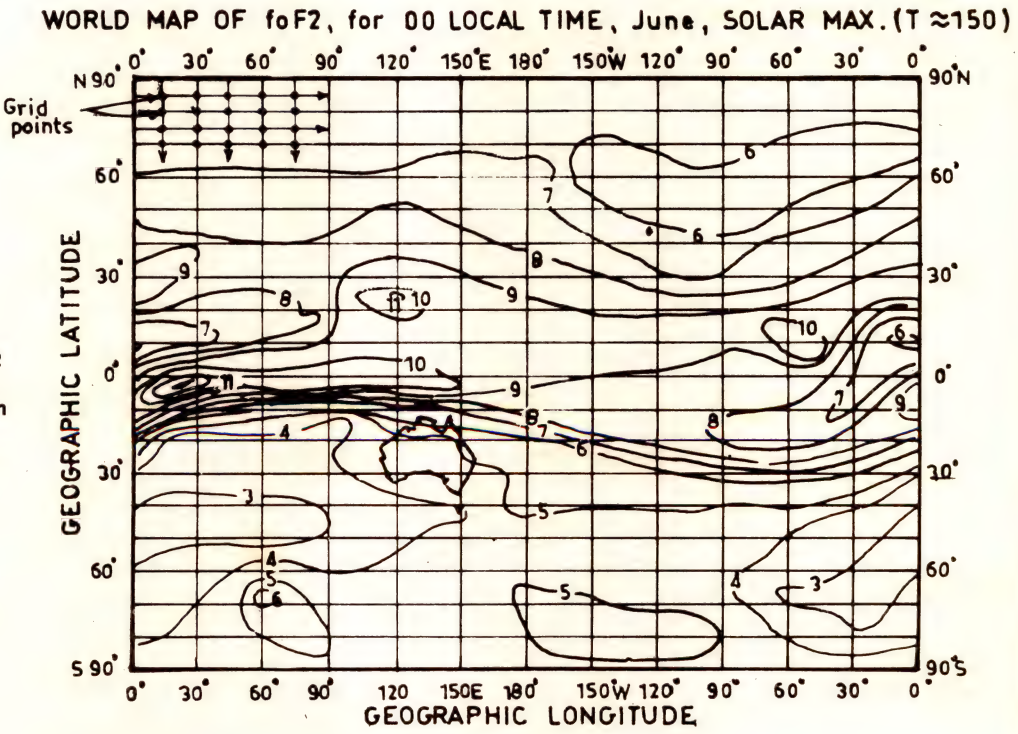
$$(988 + 441) \times 12 \times 2 = 34\,296$$

coefficients.

All coefficients are used in any set of calculations. The coefficients are stored as eight bytes per coefficient, requiring a total

CRITICAL FREQUENCY

The D, E, F1 and F2 "layers" in the ionosphere are marked by distinct changes in the electron density that occur with increasing height, as seen from the Height Profile here. When "soundings" are taken vertically with a HF radar sweeping from 1 MHz to about 20 MHz, reflections are obtained as shown in the "ionogram" here. Echoes appear first in the E-region and subsequently, with greater time delay, from the F1 and F2 regions. The frequencies corresponding to the peaks of the E, F1 and F2 layers are called the **critical frequencies,** denoted by foE, foF1 and **foF2.** Frequencies greater than foF2 penetrate the ionosphere and are lost in space. Effectively, foF2 is the MUF at vertical incidence above the location at which it is measured.


WORLD MAP OF foF2, for 00 LOCAL TIME, June, SOLAR MAX. (T ≈150)
Grid points
GEOGRAPHIC LATITUDE
GEOGRAPHIC LONGITUDE
N 90°
S 90°
0° 30° 60° 90° 120° 150°E 180° 150°W 120° 90° 60° 30° 0°

Here's what a world map of foF2 looks like. The CCIR Atlas comprises a series of maps such as this, data from which are employed in the FTZ programs.

(Courtesy IPS Radio & Space Services).

storage of 274K bytes.

The FTZ programs rely on a very simplified, but still reasonably accurate, representation of the maps of foF2 and M(3000)F2. Damboldt and Suessmann use a grid-point method to represent the maps, where the values between the grid points are obtained by linear interpolation (literally, drawing a straight line between them).

After many trials and comparisons with the CCIR Atlas, a simple table was obtained which contains the 24 local time values of foF2 for 0°, ±20°, ±40°, and ±60° geomagnetic latitude. These values were taken from the CCIR Atlas, calculated for just those grid points. There is no local time dependence for the

LISTING OF FTZMUF2

```
100 REM FTZMUF2 CALCULATES MUF. COPYRIGHT BY FTZ DARMSTADT 1986
110 DEFINT I-N : DIM F(2),FR(3),IFX(24,4,2,4),IV(4,3,3),IF9(4,2)
140 DIM MVT(12,10,2),M3C(10,21,M3T(24,2,2)):PI=3.14159
150 M$="JAN.FEB.MAR.APR.MAY JUNEJULYAUG.SEP.OCT.NOV.DEC."
160 CLS : PRINT "DATA LOADING ..." : GOSUB 490
180 INPUT "LAT., LONG. (N,E=+ S,W=-) ";X,Y
190 IF X>90 OR X<-90 THEN PRINT "WRONG COORDINATE" : GOTO 180
200 IF Y>180 OR X<-180 THEN PRINT "WRONG COORDINATE" : GOTO 180
210 INPUT "MONTH ";MONTH
220 IF MONTH >12 OR MONTH <1 THEN PRINT "WRONG MONTH" : GOTO 210
230 INPUT "SSN ";SSN
240 IF SSN<0 THEN PRINT "WRONG SSN " : GOTO 230
250 INPUT "PERCENTAGE OF TIME (10, 50, 90) ";IPER
260 IF IPER=10 OR IPER=50 OR IPER=90 THEN GOTO 280
270 PRINT "WRONG PERCENTAGE" : GOTO 250
280 PRINT : PRINT : PRINT
290 B$="N" : IF X<0 THEN B$="S"
300 L$="E" : IF Y<0 THEN L$="W"
310 PX=ABS(X) : PY=ABS(Y):IH=1:GOSUB 1290
330 MON$=MID$(M$,(MONTH-1)*4+1,4)
340 LPRINT "MUF (FTZMUF2) FOR "; : LPRINT USING "##.# ";PX; : LPRINT B$;
350 LPRINT USING " ###.# ";PY; : LPRINT L$ : LPRINT : LPRINT MON$;
360 LPRINT USING " SSN=###  ###%   GYRO=#.# MHZ";SSN,IPER,GYR : LPRINT
370 LPRINT "UTC    FOF2    M3000    MUF4000"
371 LPRINT "       MHZ                MHZ"
380 LPRINT
390 FOR IH=1 TO 24:GOSUB 1290:AMUF=F50
410 IF IPER=10 THEN AMUF=F10 ELSE IF IPER=90 THEN AMUF=F90
440 LPRINT USING "##     ##.#     #.#      ##.#":IH,AMUF,XM3,F4000:NEXT IH
460 LPRINT CHR$(12):PRINT : INPUT "CONTINUE ? Y/N ";A$
470 IF A$="y" OR A$="Y" THEN CLS:GOTO 180
480 END
490 REM ***** READ DATA FROM FILE
500 OPEN "FTZMUF2.DAT" FOR INPUT AS#1
675 FOR M=1 TO 4:FOR N=1 TO 2:FOR J=1 TO 4:FOR I=1 TO 24:INPUT#1,IFX(I,J,N,M)
680 NEXT I:NEXT J:NEXT N:NEXT M
685 FOR N=1 TO 2:FOR J=1 TO 4:INPUT#1,IF9(J,N):NEXT J:NEXT N
960 FOR N=1 TO 2:FOR J=1 TO 10:FOR I=1 TO 12
970 INPUT#1,MVT(I,J,N):NEXT I:NEXT J:NEXT N
1010 FOR N=1 TO 2:FOR J=1 TO 2:FOR I=1 TO 24
1020 INPUT#1,M3T(I,J,N):NEXT I:NEXT J:NEXT N
1040 FOR N=1 TO 2:FOR J=1 TO 10:INPUT#1,M3C(J,N):NEXT J:NEXT N
1080 FOR N=1 TO 3:FOR J=1 TO 3:FOR I=1 TO 4:INPUT#1,IV(I,J,N)
1085 NEXT I:NEXT J:NEXT N:CLOSE:RETURN
1290 REM ***** MUF
1292 GX=X*PI/180:Q=.9799*SIN(GX)+.1994*COS(GX)*COS(1.204+Y*PI/180)
1294 IF Q>1 THEN Q=1 ELSE IF Q<-1 THEN Q=-1
1296 GAX=ATN(Q/SQR(1-Q*Q))*180/PI
1300 AX=ABS(GAX):SN=SSN*.01:MON=MONTH:T=IH+Y/15:IF T>=24 THEN T=T-24
1310 IF T<0 THEN T=T+24
1320 LT=CINT(T):IF LT=0 THEN LT=24
1430 REM ..... FOF2
1435 LB=1:IF GAX>=0 THEN 1470
1445 LB=2:MON=MON+6:IF MON>12 THEN MON=MON-12
1470 MON1=FIX(MON/3):MON2=MON1+1:IF MON1=0 THEN MON1=4
1500 IF MON2>4 THEN MON2=1
1502 M1=FIX(AX/10)+1:M2=M1+1:IF M2>10 THEN M2=10
1504 N1=FIX(AX/20)+1:IF N1>4 THEN N1=4
1506 N2=N1+1
1510 BX=(N1*20-AX)/20:IF AX>60 THEN BX=(90-AX)/30
1520 DI=(MON-FIX(MON/3)*3)/3:DX=(AX-M1*10+10)/10
1650 FOR K=1 TO 2
1652 LF1=IFX(LT,MON2,K,N1):GOSUB 2260:LF2=LF1
1654 LF1=IFX(LT,MON1,K,N1):GOSUB 2260:FT=(LF2-LF1)*DI+LF1
1670 IF AX>60 THEN 1710
1680 LF1=IFX(LT,MON2,K,N2):GOSUB 2260:LF2=LF1
1682 LF1=IFX(LT,MON1,K,N2):GOSUB 2260:GOTO 1730
1710 LF1=IF9(MON2,K):GOSUB 2260:LF2=LF1
1720 LF1=IF9(MON1,K):GOSUB 2260
1730 FH=(LF2-LF1)*DI+LF1:XR=(FT-FH)*BX+FH
1740 LF1=MVT(MON,M2,K):GOSUB 2260:LF2=LF1
1745 LF1=MVT(MON,M1,K):GOSUB 2260:XK=(LF2-LF1)*DX+LF1
1750 F(K)=XR*XK:NEXT K
1760 F50=((F(2)-F(1))*SN+F(1))*.001
1990 REM ..... M3000
1995 AX=ABS(X):LX=FIX((AX+5)/10)+1:DIF=(LT-FIX(LT/6)*6)/6
2000 MON=MONTH:IF X>0 THEN 2005
2002 MON=MON+6:IF MON>12 THEN MON=MON-12
2005 CM=ABS(MON-6)/6
2010 FOR K=1 TO 2:FR(K)=(M3T(LT,2,K)-M3T(LT,1,K))*SN+M3T(LT,1,K):NEXT K
2030 BX=AX:IF BX>40 THEN BX=40
2050 BX=BX/40:XM3X=(FR(2)-FR(1))*BX+FR(1)
2060 XCMD=(M3C(LX,2)-M3C(LX,1))*CM+M3C(LX,1)+XM3X:BM=ABS(LT-12)/12
2080 XM3=((XM3X-XCMD)*BM+XCMD)/100
2090 REM ..... 10/90 PERCENT OF FOF2
2095 J1=FIX(T/6):J2=J1+1:IF J1=0 THEN J1=4
2098 IF J2>4 THEN J2=1
2100 IM=FIX(ABS(MON-6.5)/2+1):BX=AX:IF BX>75 THEN BX=75
2120 IF BX<15 THEN BX=15
2130 FOR K=1 TO 3:IV1=IV(J1,K,IM):FR(K)=((IV(J2,K,IM)-IV1)*DIF+IV1)*.01
2160 NEXT K:IF BX>40 THEN 2200
2180 FAK=(FR(3)-FR(2))*BX/40+FR(3):GOTO 2210
2200 FAK=(FR(2)-FR(1))*(BX-40)/35+FR(1)
2210 F10=F50*FAK:F90=F50/FAK*.96
2230 REM ..... MUF FOR 4000 KM
2240 GYR=AX/100+.8:F4000=F50*XM3*1.1
2250 RETURN
2260 REM ..... DECODE
2270 M=0:LW=FIX(LF1/256):IF LW>=0 THEN 2290
2280 LF1=LF1+32768!:LW=FIX(LF1/256):M=1
2290 IF LB=2 THEN LF1=LF1-LW*256:RETURN
2292 LF1=LW:IF M=1 THEN LF1=LF1+128:RETURN ELSE RETURN
2294 END
```

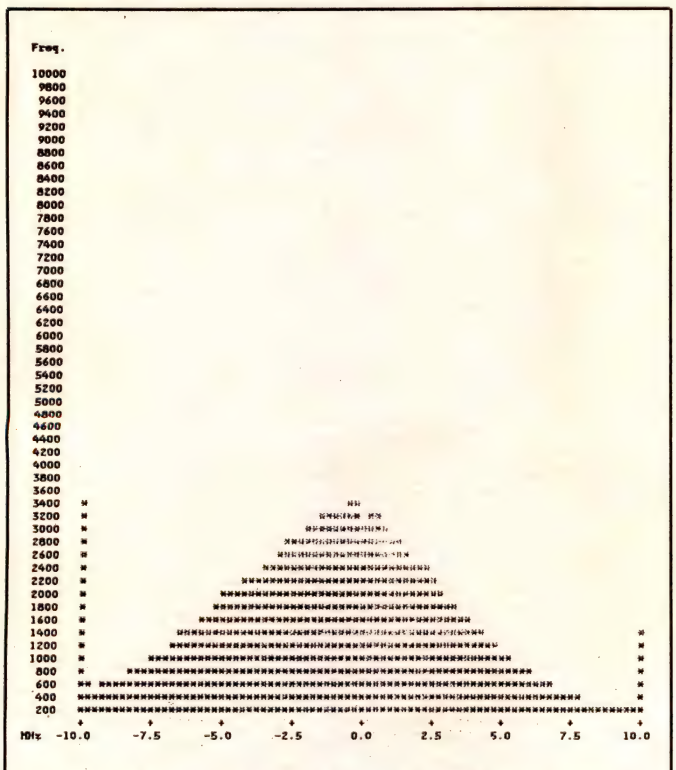


Figure 3. Histogram of the distribution of differences between MINIMUF and the CCIR Atlas for MUF(3000).

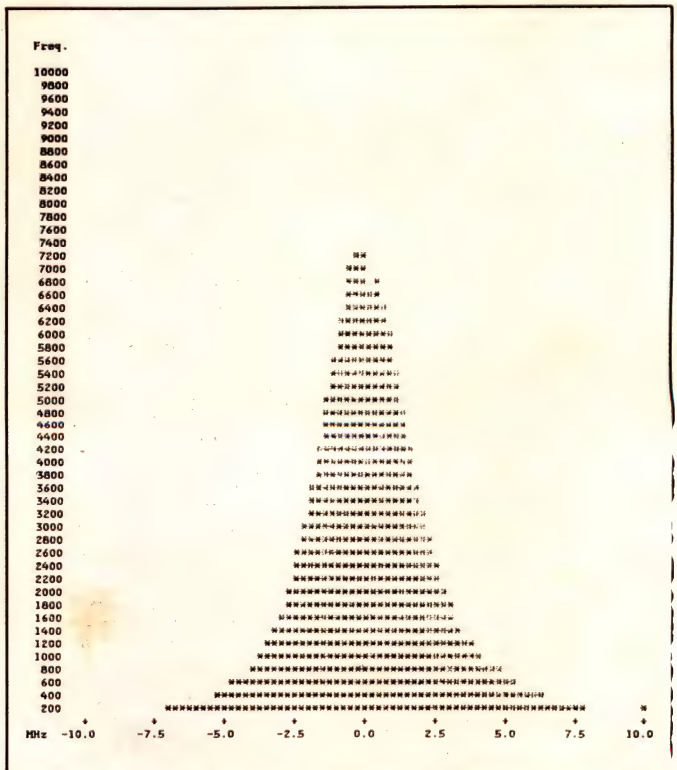


Figure 4. Histogram of the distribution of differences between FTZMUF2 and the CCIR Atlas for MUF(3000).

latitudes of +90° and -90° (that is, the north and south poles), and hence only one number for each pole is taken into account.

The table with the values for March, June, September and December and for two solar epochs (Sunspot numbers of 0 and 100), comprises 768 numbers only. Actually, each of the 768 numbers in the table artificially merges both the value of the northern and the corresponding southern hemisphere value, to save memory space. The tables are contained in a module along with the program, labelled FTZMUF2.DAT.

In applying the tables in FTZMUF2.DAT, the procedure to obtain a MUF value for a given hour (in Universal Time), month, location and Sunspot number is:

1. calculate local time,
2. change month for the southern hemisphere,
3. determine geomagnetic latitude,
4. look up foF2 for the nearest two latitude belts and the nearest months,
5. interpolate for latitude and month (including the correction),
6. interpolate for Sunspot number, and
7. calculate M(3000) and MUF(4000).

Besides calculating the median values (50 per cent values), the program also allows you to calculate 10 per cent and 90 per cent values of foF2 and M(3000).

The computer program asks you to specify these input parameters:

- geographic latitude and longitude (north and east positive, south and west negative). For example, enter the co-ordinates for Adelaide: -34.7,138.6.
- month (Jan = 1, Feb = 2 etc.),
- Sunspot number (SSN), and
- percentage of time wanted (10, 50 or 90).

The program puts out a table of the 24-hourly values of

- foF2
- M(3000) and
- MUF(4000)

for the specified percentage of time. A sample output is shown in Table 1.

Accuracy

Damboldt and Suessmann have estimated the accuracy of FTZMUF2 by comparing the predictions with those based on using the CCIR Atlas.

MUF(3000) values for each point of intersection between the latitudes of 0°, ±10°, ±20°, ± and so on (19 numbers) and the longitudes of 0°, 30°, 60° and so on (12 numbers) were calculated for 24 hours of the day, for 12 months and two Sunspot numbers, yielding a total of

$$19 \times 12 \times 24 \times 12 \times 2 = 131\,328 \text{ values.}$$

The average error in the FTZ predictions compared with those based on the CCIR Atlas is -0.09 MHz, with a standard deviation of 2.3 MHz. The standard deviation of the errors given by MINIMUF is 4.4 MHz, *almost twice as high* as the FTZ value. Figures 3 and 4 are histograms of the distributions of the errors for MINIMUF and FTZMUF2 respectively.

Conclusion

The program MINIFTZ2 is written in Microsoft BASIC, and will run under BASICA as well as under GWBASIC. The astute reader will see there is not much that can be done in a practical sense with the predicted values of MUF(4000), but all will be revealed in the second article.

MUF (FTZMUF2) FOR 34.7 S 138.6 E

OCT. SSN= 65 50% GYRO=1.1 MHZ

UTC	FOF2 MHZ	M3000	MUF4000 MHZ
1	8.2	3.0	27.2
2	8.4	3.0	27.5
3	8.4	3.0	27.6
4	8.4	3.0	27.5
5	8.3	3.0	27.3
6	8.1	3.0	26.9
7	7.9	3.0	26.2
8	7.5	3.0	25.1
9	7.1	3.0	23.6
10	6.5	3.0	21.6
11	6.0	3.0	19.8
12	5.6	3.0	18.3
13	5.3	2.9	17.2
14	5.1	2.9	16.3
15	4.9	2.9	15.7
16	4.7	2.9	15.2
17	4.6	2.9	14.7
18	4.4	2.9	14.0
19	4.2	2.9	13.6
20	4.4	3.0	14.5
21	5.2	3.0	17.3
22	6.3	3.0	21.1
23	7.3	3.0	24.3
24	7.9	3.0	26.3

TABLE 1.

Sample output from FTZMUF2 for a 4000 km path with its midpoint over Adelaide (34.7° south, 138.6° east). This lists calculations of the F2 layer critical frequency, foF2, over Adelaide, the obliquity factor M(3000) and the MUF — MUF(4000). Here, the Sunspot number (SSN) was chosen as 65 — a good approximation to the present state — and the predictions are for 50 per cent of the time. Whilst instructive, it's not all that practical unless you can manage a takeoff angle down to zero degrees for the antennas at each end.

REFERENCES

AEM, April and May 1986, "Radio Communicators Guide to the Ionosphere," Leo McNamara and Roger Harrison, parts 5 and 6.

QST, journal of the American Radio Relay League, December 1982, article on the MINIMUF program; pages 36-38.

Atlas of Ionospheric Characteristics, Report 340 of the Consultative Committee for International Radio (CCIR).

The programs FTZMUF2 and MINIFTZ4 are available together on one 5.25" disk to run under PC-DOS/MS-DOS, from:

AEM Software Service,
1st Floor, 347 Darling St,
BALMAIN 2041 NSW

The cost is $22, which includes sales tax, plus post and handling. Payment may be by cheque or money order, or you may quote your credit card details (name, no. & expiry date).

Novices! Welcome to two metres

— a primer, Part 3

Ben Furby VK2XNZ and Roger Harrison VK2ZTB

"Get the right connections" , we told you last month, to get the most out of your 2 m rig. Connections — to what?

WELL, IT'S A TRUISM on the VHF/UHF bands that a station is only as good as its antenna. A magnificent array will waste your money if it is not high enough, and clear of nearby obstructions. Of course, you might manage some freak results through reflections off local steel reinforced tower blocks etc, but do not count on it.

If you are on the ground floor of a 10-storey block of flats in the middle of several other buildings in downtown Sydney, give it away. If you cannot get an antenna on the roof, you either hand in your licence or move! You could confine all your operating to mobile, if you could be so lucky to festoon your vehicle with the appropriate hardware.

First law

That's the first law of VHF/UHF antenna lore? On the lower amateur bands, where achieving even a ¼-wave Marconi antenna begins getting you into dimensions that are too big for the ordinary backyard, the earth assumes considerable importance. Therefore, good ground conductivity is necessary, and being in a valley with good conductivity soil will often do better for you than if you were up on a mountain where you had height but poor soil conductivity.

The range of VHF/UHF stations — without recourse to repeaters - is decided by these factors: • the antenna; • the feeder; • the receiver; and • the transmitter.

Getting the antenna as high as you can is the first law. The "height of the antenna above average terrain" (HAAT) is significant in VHF/UHF propagation, and why you get it as high up in the air as you can, which is usually on your roof. The 30 m self-supporting tower is a worthwhile goal, but let's confine this discussion to the widest practical applications for now.

Getting the antenna on the roof is only part of the battle, too. Be sure to consult your coax cable tables to check losses per 100 m for various cables. Assuming you can get to mount an antenna on the roof of your 10-storey block and get your cable up through the cable ducts with the building supervisor's permission, the losses may be too high to let you get enough power out.

So you're back to packing up and moving, or going mobile.

Next scenario: you've gone through the moving trauma in the most worthy and excellent cause of amateur radio, and you're on the second floor of a three storey block of flats with a clear view of surrounding suburbs.

In the country, if you want to get out on 2 m you do the reverse. You have to give up your home in the valley and build a house on the highest peak you can get mains power to. That way, you'll really be into 2 m DX.

If you cannot (a) mount a decent antenna where you live and (b) are unable to move, do not despair, dear reader, as they used to write in books last century (BAR, which stands for the Dark Ages: "Before Amateur Radio"). Kenwood, Icom and DSE offer handheld 2 m portables. So you can always take off for the Dandenongs or those hills up behind Adelaide and have a ball with only 2.5 W or so of power. Antenna height makes up for a lot of watts!

Simple antenna solutions

A good start is to look up the catalogues of hobbyist shops like Dick Smith Electronics (DSE), Emtronics or Tandy. For example, DSE has its "Folded J" 2 m vertical, cat. no. D-4211, which promises to cover the full 2 m band with a VSWR of <1.2:1. It is rated for 500 W, which is more than any novice would be wanting for a very long time (let alone the other grades!). Or a vertical bottom-fed ½-wave whip (that means, the coax connects at the base — not what you were thinking!). They're otherwise known as "ground independent" whips. But how to mount these?

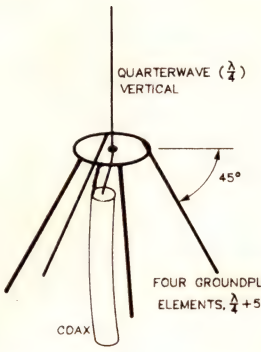
In both the DSE and Tandy catalogues you will find a host of antenna accessories, such as U-bolt and saddle clamps, chimney and wall mounts. These are TV antenna fittings, but are ideal for modest amateur antenna erections.

For a "quickie" antenna, build yourself a *groundplane*. This is a simple omnidirectional antenna consisting of a vertical element a quarterwave long with four horizontal 'groundplane' elements connected together and mounted at right angles to each other at the base of the vertical. It is conveniently fed with coax, the centre conductor to the base of the vertical, shield to the groundplane. The groundplane elements, or 'radials', are about 5% longer than a quarterwave. However, its feedpoint impedance is less than 50 Ohms, around 35 Ohms in fact. The impedance is easily raised to match the coax impedance by the simple expedient of 'drooping' the groundplane radials 45° from the horizontal.

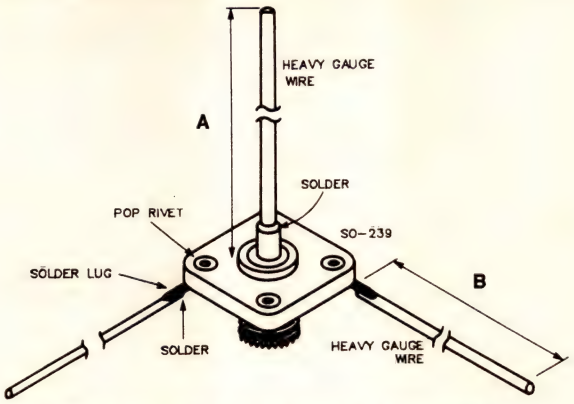
The accompanying diagrams show the general arrangement and how to construct one from an SO239 panel-mount socket and heavy gauge wire. The vertical element is cut to 490 mm length, while the groundplane radials are cut 515 mm long. You can use tinned copper wire, or enamelled copper wire. As a minimum, 18 gauge wire is recommended. Brazing rod may be used in lieu of wire and it has the advantage of being stiff and springy, but you'll need to use heavy duty solder lugs on the radials.

The quickie groundplane is easy to mount. Your feedline with PL259 connector on the end plugs into the SO239. You can erect a short length of pipe of about 20-25 mm inside diameter and drop the feedline through it, letting the SO239 sit in the top of the pipe, as shown in the illustration.

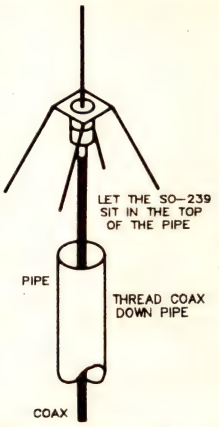
Alternatively, you could mount a mobile antenna mounting on a small, square



General arrangement of the "quickie groundplane".



Construction details of the quickie groundplane. The vertical, A, is 490 mm long. The radials, B, are each 515 mm long.



The quickie groundplane is simple to mount, like this.

metal plate (the baseplate) of, say, 1-2 mm thick aluminium about 50 mm a side, with the radials soldered to solder lugs pop-rivetted to the plate. The antenna can be mounted to a vertical pipe using a small length of aluminium angle bolted to one edge of the baseplate, and a U-bolt used to bolt the assembly to the pipe. For the vertical, you could then choose a suitable mobile whip. If you use a $\frac{5}{8}$-wave whip, set the radials horizontal and you'll get a good match to your coax as well as a little gain.

Beam it up, Scotty!

It is when you move into the wonderful world of *Yagi* arrays that you feel you are up there really living with the 2 m high fliers. At this stage the discussion gets more polarised.

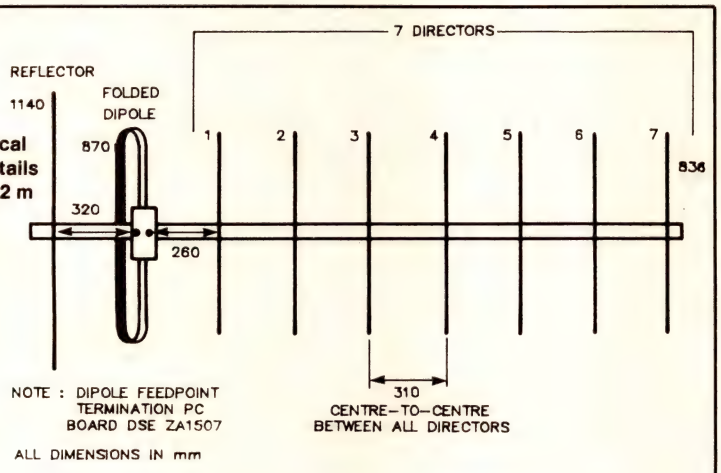
In the high end of the 2 m band, vertical polarisation is the rule. Now this has no force in law but is by time-honoured agreement among operators. It came about that FM activity began mainly as mobile-to-mobile and mobile-to-base, and as vertical whips are much easier to install on vehicles, vertical polarisation became the rule.

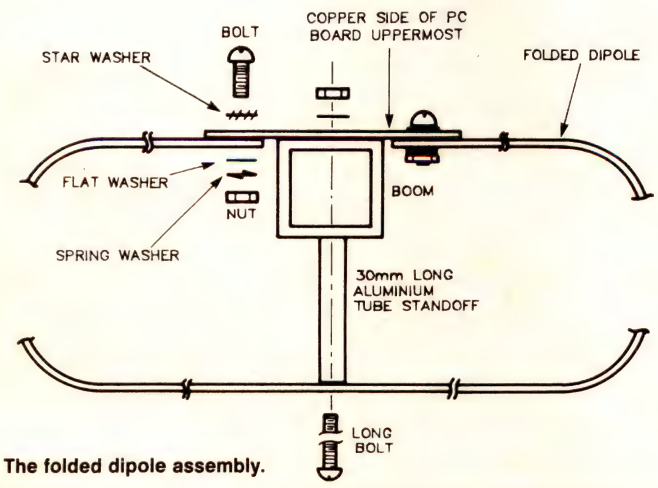
On the low end of 2 m, horizontal polarisation has the whip hand. How you polarise your Yagi depends on what you want to do on 2 m, and where the activity in your locality is all at.

We repeat here the dimensions for building a 9-element 2 m Yagi, first published in AEM a couple of years ago (April '86). It was put out as a kit by Dick Smith electronics, cat. no. K6297. The beam was designed to be simple to make, using directors all the same length and spacing, mounted on a mechanically-manageable boom length. This gives about 10 dB gain, which in the interests of getting you out into the action is a great help and not to be sneered at.

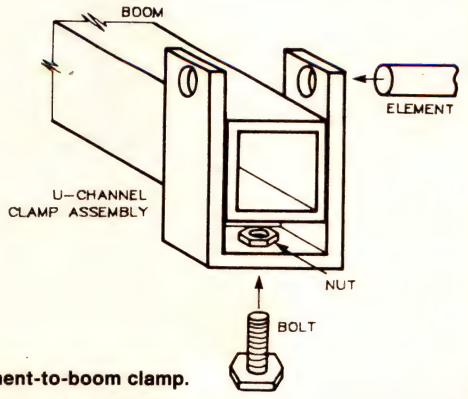
All the directors and the reflector are cut from 9 mm diameter aluminium tubing. The folded dipole is made from 10 x 3 mm aluminium strip and its end-to-end length is 870 mm. The directors are 836 mm long and spaced 310 mm apart, but spacing between the first director and the dipole is 260 mm. The reflector is

General mechanical and assembly details of the 9-element 2 m Yagi beam.

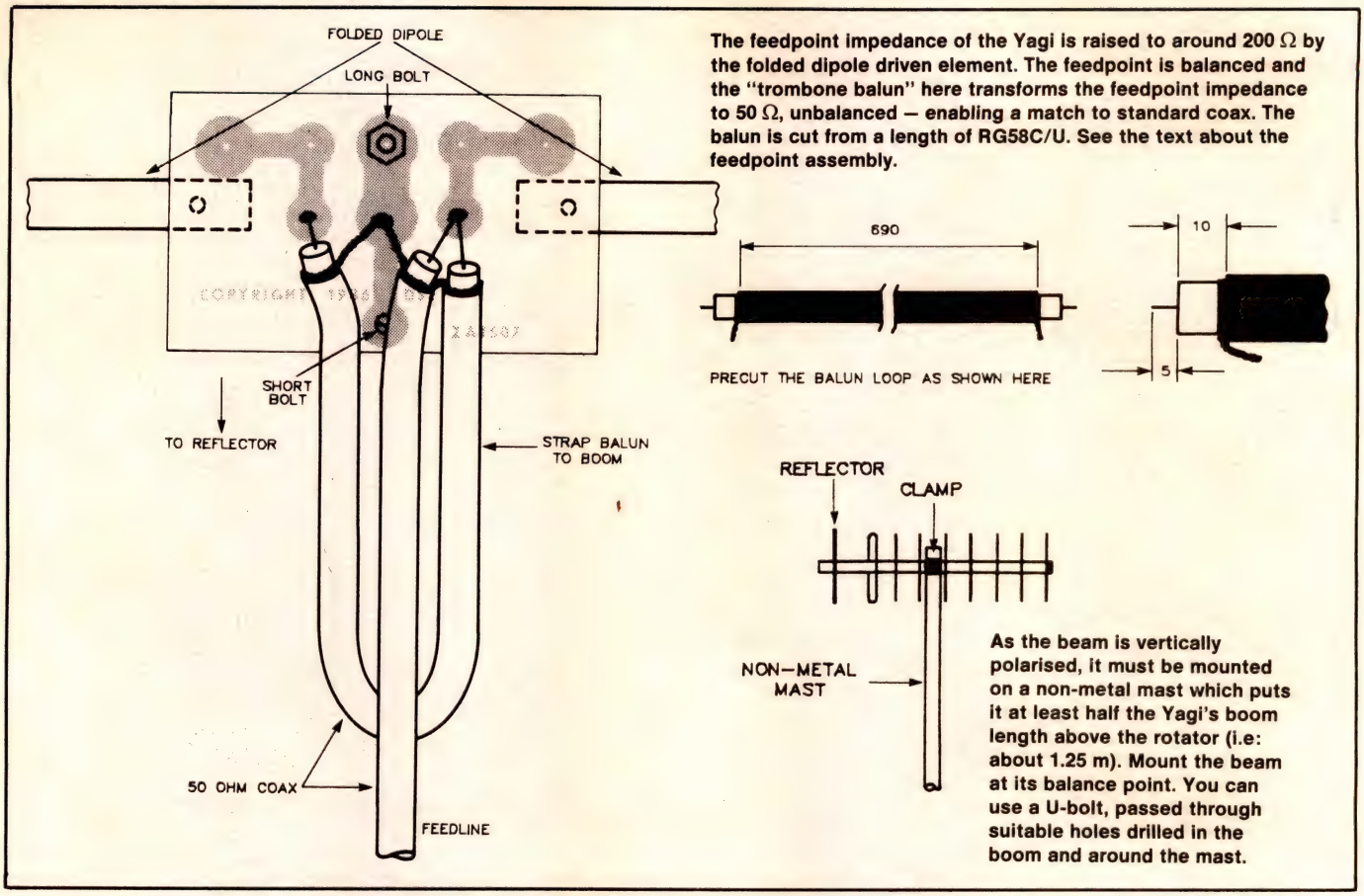




The folded dipole assembly.



The element-to-boom clamp.



The feedpoint impedance of the Yagi is raised to around 200 Ω by the folded dipole driven element. The feedpoint is balanced and the "trombone balun" here transforms the feedpoint impedance to 50 Ω, unbalanced – enabling a match to standard coax. The balun is cut from a length of RG58C/U. See the text about the feedpoint assembly.

As the beam is vertically polarised, it must be mounted on a non-metal mast which puts it at least half the Yagi's boom length above the rotator (i.e: about 1.25 m). Mount the beam at its balance point. You can use a U-bolt, passed through suitable holes drilled in the boom and around the mast.

1140 mm long and 320 mm from the dipole.

The elements mount on a 19 mm square-section aluminium boom, using an element-to-element boom clamp made from a piece of 25 mm U-channel, as shown in the drawings.

The dipole has a balanced input, but coax is unbalanced. So we show constructional details for making a "trombone" balun from a piece of 50 Ω, RG58C-U commercial grade coax. This is cat. no. W-2092 at DSE. The matching coax stub for the balun is 720 mm long, and you cut back the outer sheath 15 mm from each end. Unbraid the shield and twist it into a "tail", bare the centre conductor for 5 mm and solder it to the pc board as shown in the diagram. Now: if you cannot make up a pc board as shown, do not despair. Just a piece of plain board (such as "perf board"), without the copper conductors, can be made up with substantial (say, 18g) copper wire leads.

Use some silicone sealant to protect the electrical connections from rain, snow, hail and all the Australian weather can throw at it.

This antenna was designed to work across the whole band and it shows a voltage standing wave ratio (VSWR) of 1.5:1 or better, over 144 to 148 MHz. Gain is about 12 dB with respect to a dipole ("dBd") and the front-to-back ratio of 17 dB. The measured 3 dB beam width (E-plane) is about 50°.

Swing it

Next step: have beam, how to swing it round? Well, you can work out some arrangement for turning it manually, bearing in mind you are down there on the ground and it is high up in the air. Also, that you want to swing it accurately on to the station you want to work, and not a few degrees off, so making contact marginal. "Accuracy", here, is a relative thing. It becomes more important the longer this distance is between you and the station you're working.

So the Armstrong (physical manipulation) method needs rethinking, like the actress said to the bishop. Pulleys, endless rope, or a crank? Yes, that's a possibility, if that's the way you want to go.

However, through the modern miracles of electricity, you can buy a motorised mechanism to do all the work for you. Now, think about what are some essential elements for such a thing. First, you cannot have 240 Vac up your mast, so you work on a lower voltage, isolated from the mains. The antenna must swing through 360°, but not continuous circles, unless you have a way of stopping the coax from being twisted around the mast. It should be able to traverse 360° and then reverse the full circle.

While the motor and gears need to be strong enough to turn the antenna, they also need to be substantial enough to withstand high winds and wind gusts.

If your antenna is mounted on top of a reasonably high mast, it gets a bit boring lowering the mast or climbing around the roof too often, repairing cables or replacing the rotator. Expensive, too. Remember that if your gears stripped in a high wind, the antenna would "weathercock", that is, swing freely as the wind directed and the cables allowed. After a bit of wild winds, the cables would give up the ghost and add to your repair chores.

Also, while you are happily tucked away in your hamshack/operating niche by the fireside, it would be nice to know what the antenna is bearing on, or that you could turn it until it was on the bearing where you expected to make your sked: without having to go outside and see.

So if you do not want to have to replace your unit because it stripped its gears during a wind gust, you make sure you buy a substantial unit, and not an el cheapo. Look for the type where the antenna bolts to the side of the unit (useful for a vertically-polarised Yagi) , or the coaxial or pear-shaped one where the bottom mounts on the mast top and the antenna couples on top.

Most rotators incorporate stops at 360° so you cannot twist the leads and the coax round the mast. Also, check that the model you choose comes with a direction indicator. Home made ones are not usually so successful, and give you trouble

• to page 116.

VHF a vital link in the Australian Bicentennial Everest Expedition

Adam Searle

One factor in the success of the Australian Bicentennial Everest Expedition earlier this year, was the use of VHF communications between the climbers and the support teams.

The tiny Philips PF-85 Pocketphone VHF transceiver proved robust, reliable and easy to operate. Here, members of the expedition are using the transceivers at a spring base camp below the snow line on Everest.

ON THE MORNING of May 28, 1988, Australian climber Jon Muir, cameraman for the Australian Bicentennial Everest Expedition, struggled the last few steps to the summit of Mount Everest, the world's highest mountain. Taking out his Philips Pocketphone VHF transceiver, he communicated his arrival down the eight thousand feet to Camp Two.

Captain Terry McCullagh, expecting to hear news of a failed attempt was instead talking to someone on top the world, literally.

A fortnight before, Major Patrick Cullinan and Mr Paul Bayne had reached the summit. Of the 18 climbers and eight Australian support staff, eight members had made a summit attempt. Only three had succeeded.

It was the first expedition to have scaled Everest without the help of high altitude Sherpas and large numbers of porters to carry their equipment through the dangerous Khumbu Ice Fall and beyond. More than a tonne of oxygen, food and equipment was carried by the Australians over the long journey.

A vital element

Philips Mobile Communication Systems had provided twelve PF-85 VHF transceivers, battery packs, solar recharging equipment and other ancillaries. Major Peter Lambert, the man responsible for the ABEE communications arrangements, said the mobile radio communication was a vital element of the team's success.

Twice each day for more than two and a half months, the handheld transceivers were used for updates on route conditions, supplies, climbers' health and the leader's instructions, as well as the less critical, but equally important messages like: "Has the beer arrived at Base Camp?" ▷

One radio was kept at each of the four high camps, with a couple of spares at Camp Two. At Base Camp two radios were kept permanently in their solar recharging adaptors, so they would always be fully charged. Whenever a team moved on the hill, they took a radio, which was especially important in the exploratory stages of any part of the journey.

When the temperature was too low for the NiCad batteries to retain their charge, dry cell batteries were also used as standby power for the radios. Climbers were required to take the batteries to bed with them to keep them warm to retain their charge.

The radios used had been supplied by Philips to Australian emergency services and operations like the construction industry, and had been tested in the Australia/New Zealand 1987 Everest trials. There were no problems with transmitting or receiving. The lowest VHF band available to the PF85 (around 68 MHz) was used to maximise the possibilities for refraction around the corner of West Shoulder of the valley.

A worthwhile improvement for future expeditions would be elevated or higher gain antenna systems for Base Camp, which the team did not have time to develop. But all up, the PF-85 proved robust, reliable and easy to operate, according to the reports, even in the most hostile environment in the world — the peak of Mount Everest.

When the team descended, one of the items left behind at Camp One was a VHF Pocketphone.

Portable solar panels were used for recharging the nickel cadmium batteries used to power the transceivers. The panels can be seen in the foreground here.

☞ **FUNDAMENTALS, from page 58.**

Figure 9(b) shows where the induced voltage V, which was generated by the coil's inductance, can continue the current through the coil, but now via the diode. Notice that during this time the diode is forward biased.

Consider what would have happened if we had used a transistor to do the switching instead of switch S. Particularly, recall how in part (c) of the experiment, that high voltage spike which the relay coil's inductance generated: when diode 1N4004 was not in the circuit.

Such large voltage spikes are notorious for causing transistors and integrated circuits to break down electrically, ruining the electronics. And the culprit is the loads's inductance, in this case the relay coil.

Protecting transistors. We cannot remove the relay coil's inductance, 'cause if we did it wouldn't work as a relay. Because we must provide some precaution, the diode 1N4004 is a very safe move to take.

Other components are sometimes used rather than the diode, particularly if the fastest speed is wanted, or if there is doubt about voltage polarity at the relay coil. Capacitors (to swallow up the voltage spike), voltage-dependant resistors or surge arresters are also used for this protection.

Exactly the same problem appears when transistors or integrated circuits are used to drive transformers, swinging chokes (inductances), motors, bells, vibrators, or any load containing inductance. In every case all transistors and ICs must be suitably protected against those voltage spikes.

There we should leave this little bedtime story until next month, and let you get some sleep. 'Bye for now.

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☞ **NOVICES!, from page 114.**

modifying the rotator to accept them.

The rotator should have a strong, secure mounting, else the whole antenna/rotator system will not be secure.

The Yagi described here is readily rotated with a TV-type antenna rotator as its size and weight fall well within the capabilities of these rotators.

Finally: the basic rule with low voltage power feeds, as in the case of the control voltage to the rotator, is that to get the power, the current goes up and the voltage goes down. And when current increases, I^2R (that, is, resistive) losses increase by a factor of four. So use good, heavy cable for the control lines.

Look up, and live!

In concluding, we should mention a warning about the lethal attributes of 240 Vac. If you are mounting an antenna on the roof, side or chimney of a house, beware of the mains leads coming into the building.

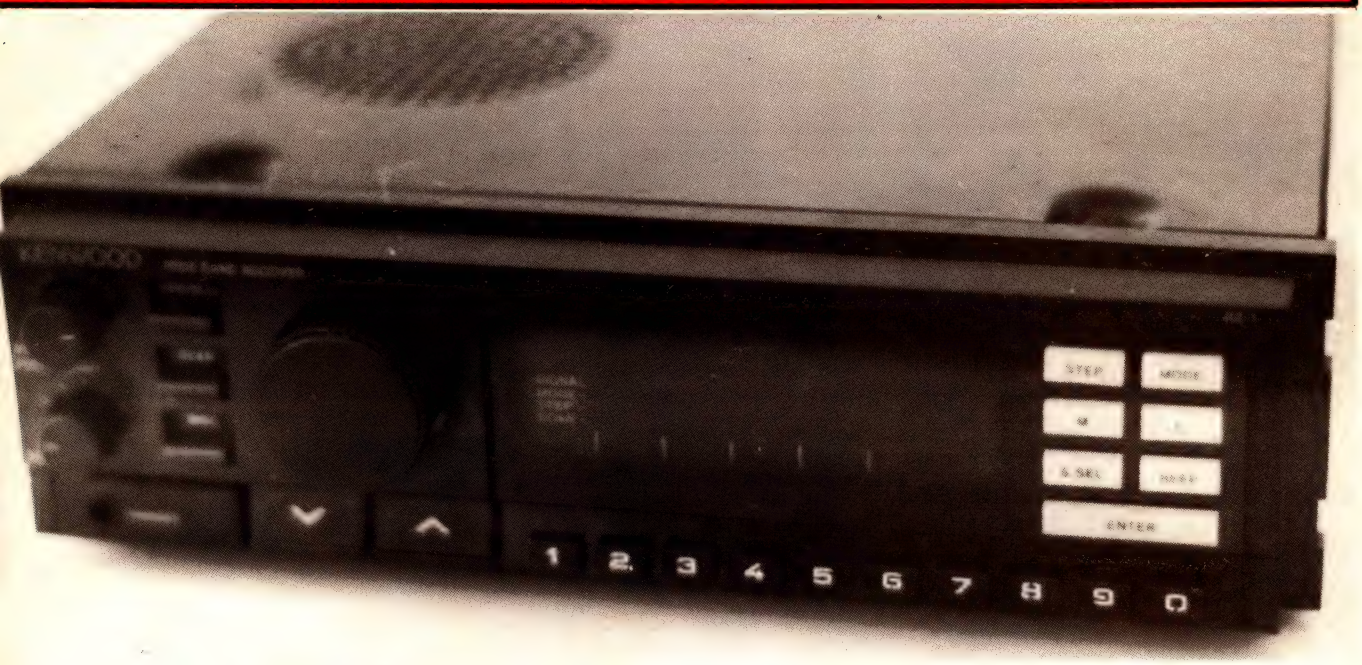
If you are installing your antenna alongside the mains lead-ins, you are working in a highly hazardous area. If you were to slip and fall on the mains or grab the lead-in, you are probably working from an aluminium ladder on damp earth or possibly wet concrete. These provide the ideal circumstances for you to complete a circuit to earth for the 240 V.

As you die, galvanised with shock, console yourself that if going out this way was your last act while alive, you did at least do the electrical conductor job pretty well, all things considered.

The easiest way of staying alive to enjoy the delights of ham radio and further issues of AEM, is to keep well away from the mains. All those people you see walking around, or whom you call up on the rig, are alive today solely because they did not take foolish chances with the mains.

3RD BIRTHDAY CONTEST No.7.

Win this scanner's delight, the Kenwood RZ-1 Wideband Receiver. Worth $1045!



The RZ-1 scanner from Kenwood provides continuous reception from 500 kHz to 905 Mhz. The AM and FM broadcast bands are covered in their entirety. Designed to be installed in a vehicle, but equally "at home" in a base station installation, the RZ-1 operates on 12 Vdc and can accept either a Motorola-style antenna plug or the PL-259 style familiar to mobile transceiver users.

Boasting 100 memory channels, the RZ-1 stores not just the frequency, but also the mode of the station as well as an optional seven-character alphanumeric identifier. Unlike many other scanners, the RZ-1 is ideally suited to replacing a standard car radio, as it duplicates all the conventional broadcast band functions as well as providing a wealth of features for MF, HF, VHF and UHF reception. All of these features are available in a remarkably compact package, measuring only 180 x 50 x 176 mm.

You can use it mobile, or use it at home! *And* we'll throw in a "Squeeky Clean" LF-4 Mains Filter from local manufacturer K.C.C., so you can pull in those signals free from mains-borne interference.

The Kenwood RZ-1 was reviewed in our June 1988 issue.

Prize kindly donated by Kenwood Australia.

1) Who is the Communications Products Manager for Kenwood Electronics Australia?

. . . . . .

2) Would you or would you not be able to pick up the Kingsford Smith weather broadcast on the Kenwood RZ-1 receiver?

. . . . . .

3) In what Sydney suburb is filter manufacturer K.C.C. located?

. . . . . .

Tell us, in 25 words or less, what features of the Kenwood RZ-1 receiver best suit your needs.

I have read the rules of the contest and agree to abide by their conditions.

Signature: _____

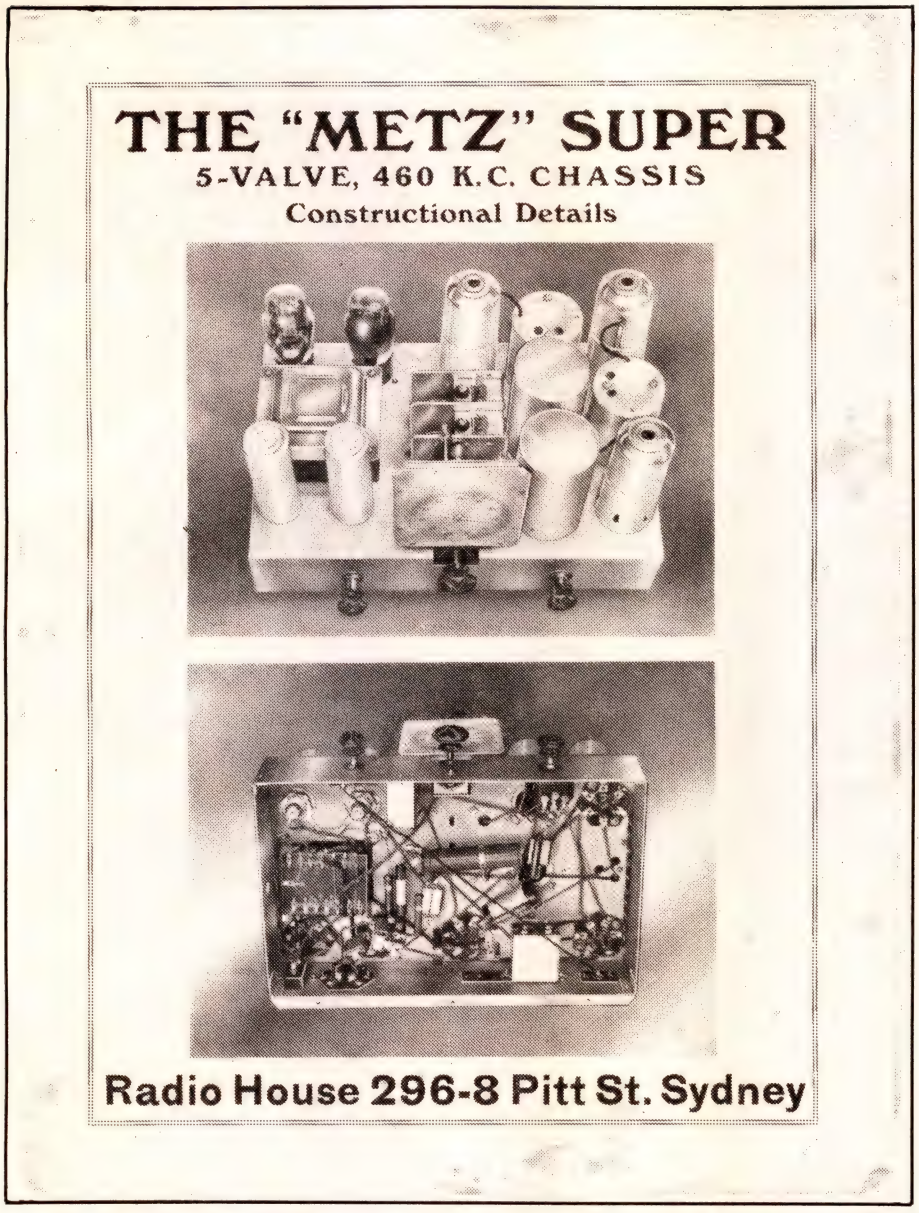
Name: _____

Address: _____

_____ P/Code: _____

Phone: (___) _____

☞ VINTAGE RESTORATIONS, from p.85.



looms, and replaced all (or most) of the capacitors with more modern ones. (I was told they were the most likely source of any future trouble.) I would have replaced the resistors also, but the ones in there are made of some sort of ceramic material, and tested well, so I decided to leave well alone in that department.

Over the years I have constructed a millivolt meter, a signal generator (both transistorised) and bought myself a Dick Smith oscilloscope to test and line up these (and other) machines. I have made several transistorised capacitor microphones. I wonder if you will be publishing a construction project for a VTVM?

So you can see, I was delighted to see that someone is going to do something for the "bottle brigade".

To end up with a plea for HELP, when trying to read the output from these machines on the oscilloscope, all I seem to be able to get on the screen is a picture of the bias signal (56 kHz in this instance). Is it possible to use a simple (I stress simple) filter to filter out this bias signal, and just leave the audio signal for measuring on the mV meter?

Also, can you tell me where I can get a nine-pin plug and socket (same size as the old bakelite valve holder, about 1⅛" diameter) so that I can extend the plug harness to the amps? I have an eight-pin plus, they are fairly commonplace, but I need to be able to make up an eight-pin, and nine-pin loom so that I can withdraw the amp. from the recorder in the live condition.

I look forward to reading your articles, and also answers to my queries.

G. Sollers,
Devonport, Tas.

Thank you for writing. We're glad to see you find this a magazine where you can expect some attention.

We admire your loyalty to these veterans of an earlier age. No sneering: this was the state of the art in those times and what we use today will look anachronistic to our successors when they browse through AEM's latest issue in decades to come - perhaps in an IC feeding the flat screen colour TV (no paper!)

However, regarding your tape recorders, better you than we. If we need that sort of exercise, we'll go straight into weight lifting at the gym.

We are interested in what tapes you are using: are they of similar vintage, because modern tapes need different bias, and your machines at wrong bias levels could possibly be detracting from performance.

We can't propose a filter for taking out the bias signal: try putting 1 kHz tone through the audio input, and slowing the oscilloscope reading speed to sync with that. If you need to read mV, you should be able to measure them this way.

A 9-pin socket, the size of the old octal valve socket? That sounds like a Philips "loctal" socket, and unless our readers can help, we can't. The usual thing today would be to remove the old socket, then mount a plate over the hole and use a multi-pin DIN or similar small plug and socket with enough pins to do the job.

A kit from yesteryear

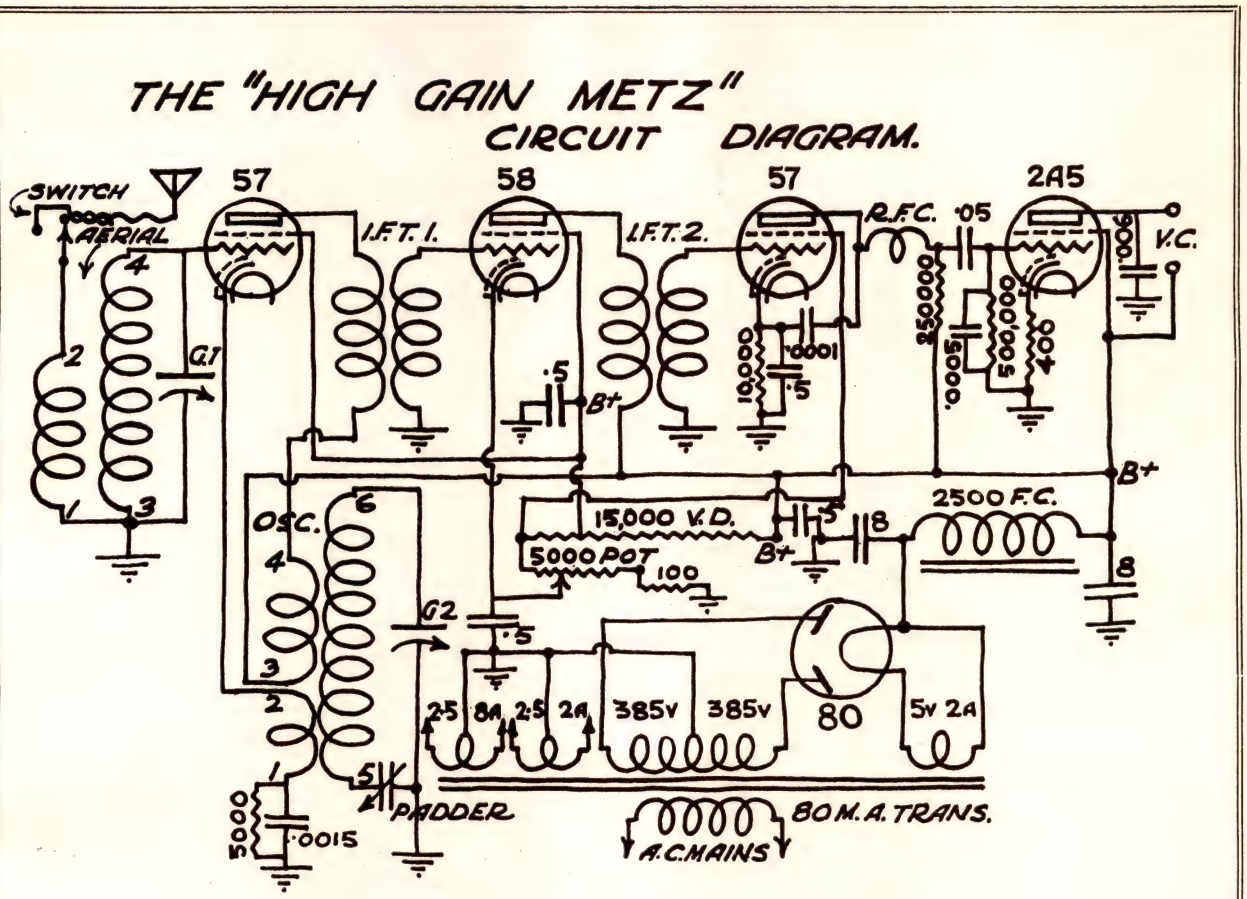
Stewart Day, from Melbourne, loaned u a fascinating 8-page pamphlet which de scribes the construction of 5-valv superhet receiver, the "Metz" Super from *Radio House*. The publication, pic tured here, clearly dates from the late 30s/early-40s. While the organisation stil exists, it no longer deals in kits as such.

The circuit (also reproduced here), lay out, components and general construction are typical of the period. A "cake pan" chassis is used, with the major compon ents — mains transformer, filter electro lytics, tuning gang, valves (socketed) coil and IF transformers, mounted on the to side. All the minor components and inter wiring are contained within the under side of the chassis.

A volume control and aerial switch ar located on the front apron, with th tuning knob and dial being part of an as sembly mounted in front of the tunin gang. The power input, speaker and aeria connections are mounted on the rea apron.

The circuit is relatively simple an straightforward. The valve line-up con prises a 57 mixer/oscillator, a 58 IF ampl fier, a 57 detector and a 2A5 audio outpu The rectifier is the famous 80. The gri connection to the 57 and 58 are eac brought out to a cap on top of the valve glass envelope (the "grid cap"). All th valves have 2.5 volt filaments.

The rectifier is quite conventional wit a pi-section filter. The interesting thin here is that the filter choke is actually th electromagnetic coil on the loudspeake providing the moving coil speaker's ma net. The HT current passing through th coil creating the magnetic field. A volta divider system provides the appropria



creen voltage for the mixer and IF valves

The 2A5 employs cathode bias without ypassing. Note the capacitors shunting he grip and plate to ground. The grid hunt (0.0005 µF, or 500 pF) gets rid of tray RF from the detector, this capacitor nd the RF choke in the detector's anode ircuit providing a low pass filter, in conunction with the 100 pF anode-cathode apacitor in the detector.

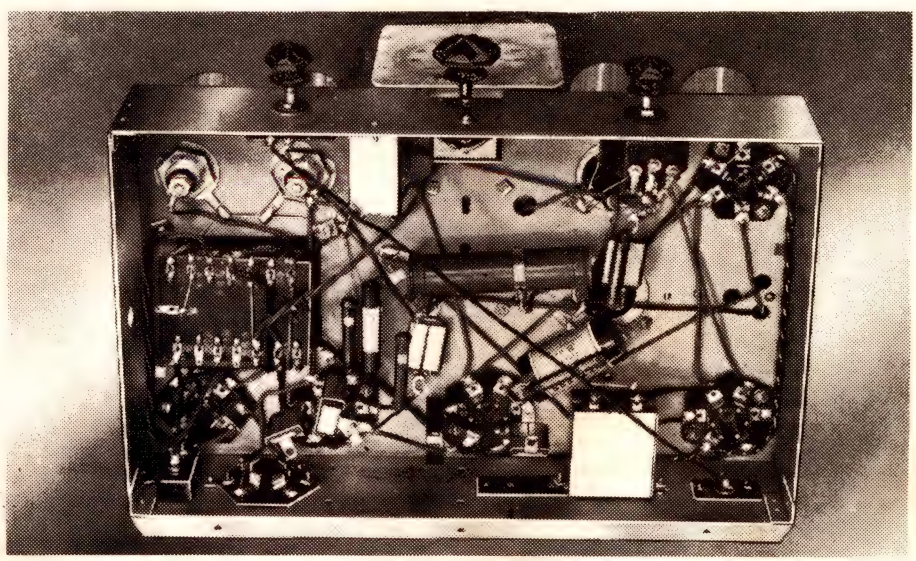
The detector employs the non-linear node characteristics of the valve to recfy the incoming amplitude modulated F signal from the last IF transformer. The creen is fed with a lower voltage than ıe mixer and IF and, curiously, it is unypassed. Note that, although not shown ere, the IF transformers have tuning caacitors in parallel with each coil.

The volume control arrangement may eem a little unusual. The 5000 Ω pot is art of the screen voltage divider netork, providing a variable positive voltge to the cathode of the IF valve. As the ositive voltage increases, the effective id bias increases, reducing the amplifiction factor of the 58 which was a speally produced version of the 57 with a id bias characteristic that permitted this rt of gain control. Note that there is no rm of automatic volume or gain control VC or AGC). Hence, any fading would ot be compensated for.

The mixer is a delight in simplicity and component efficiency! The oscillator tuned circuit has two coils coupled to it, one in series with the cathode and one in series with the anode; the 1st IF transformer primary also being in series with the 57's anode. This provides a Hartley oscillator arrangement.

The aerial tuned circuit is connected directly to the 57's grid. An external aerial may be connected directly to the aerial link coil or via a small "gimmick" capacitor made from a length of twisted hookup wire. The station signal and oscillator signal effectively mix in the cathode and anode circuits of the 57. Note that the screens of the 57 mixer and 58 IF amp both share the same bypass capacitor.

The variable "padder" (a trimmer) capacitor in the oscillator tuned circuit serves to maintain the relative difference between the signal and oscillator circuits, assuring they "track" with the least variation in accuracy across the range. We might look at this subject in a later column in a discussion on alignment.



Uninterruptible power supplies — an important safeguard in computer systems

Brian Donaldson

A computer or computer system powered from a supply which may be arbitrarily absent at any time is an unreliable system. Buying and installing some uninterruptible power supply (UPS) is the solution, but that's not all there is to it.

A VITAL safeguard of functional security in any computer system is the smooth and uninterrupted supply of 'clean' power because computers are becoming increasingly important 'tools' and any computer is sensitive to certain power fluctuations and critically dependent on continuous supply.

Most environments where computer systems are installed can be described as "electronically hostile". Computer manufacturers are increasingly concerned about ac line transients, and grounding and voltage variations which occur on the computer system at the customer's site. Yet these disturbances are not always taken into account during the planning stage of a computer installations.

If ac power line disturbances are not considered in the basic design, the effects of the power anomalies may make themselves felt without warning — to the operator's cost.

At peril

Such effects appear in may forms. The equipment may suddenly stop operating. Errors may occur in normal processing cycles or be introduced into the data files and programs. And expensive hardware damage may occur.

The solutions to these problems require an understanding of the anomalies present on ac power sources, and of the computer system's sensitivity to such anomalies.

If the system manufacturer incorporates devices to protect the computer against all possible ac disturbances the initial cost of the unit will increase. But the customer expects maximum use of the system with minimum maintenance and downtime.

A compromise is required to minimise overall customer costs. This can be achieved partly by improving the environment of the computer system, and also if the manufacturer specifies the environment required and explains the tolerances within which the system can safely operate.

To overcome threatening power supply problems and be assured of 'clean' power, most installations have decided to install uninterruptible power supply systems, which provides the system with autonomy from the power for a period. In some cases these are coupled with a diesel/alternator to extend autonomy time.

Planning

In planning maximum performance from such a critical uninterruptible power supply system, there are a number of basic parameters which must be met and incorporated:

- Good overload capacities without impairing the quality of the voltage supplied.
- The ability to operate without risk on very unbalanced loads.
- A very high overall efficiency which can reach 93%.

Selection of the UPS best suited to your computer should be made after careful analysis, considering three main criteria:

- Physical criteria depending on technical specifications required by the load.
- Functional criteria connected with the operating conditions of the equipment and the nature of the computer application.
- Subjective criteria relating to the suppliers reputation, the reputation of his equipment and the quality of his organisation and service.

Brian Donaldson is the National Marketing Manager, Electronic Power Systems Department, Merlin Gerin (Aust) Pty Ltd.

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Customers are asked to return this product as a matter of urgency to the nearest Dick Smith Electronics Store for immediate attention to the problem.

We apologise for any inconvenience caused. Further enquiries may be made by contacting Rex Callaghan, Technical Services Division on (02) 888 3200.

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APLAB offer a complete range of regulated DC bench rack power supplies combining high precision and regulation capabilities with continuously adjustable outputs.

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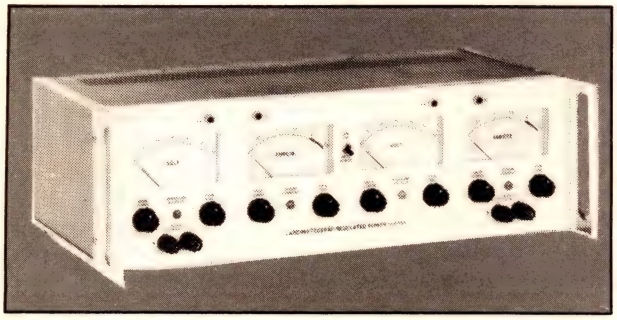

Standard models include:

SINGLE OUTPUT
OUTPUT: Output VOLTAGE: Current
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DUAL OUTPUT
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Keeping power problems at bay

David Kingsley

As mains-operated electronic and computer equipment becomes more sophisticated, and the systems that they support become more dependent on them, the necessity for reliable operation increases many-fold.

WHEN MAINS-POWERED electronic and computer systems do not perform in a reliable way, problems on the mains are often at the root of it. Unless you've got your own power station, your reliance on the mains is absolute. Thus, you have to live with whatever disturbances occur on the ac mains. But you can take steps to eliminate or minimise their effects using, depending on the nature of the problem(s), power line filters, power conditioners, a standby power source or an uninterruptible power supply.

Each of these remedies suits differing problems and problem levels, and each has their application. But first, just what *are* the problems that arise on the ac mains. The feature in the February 1988 issue of AEM, *Smoothing Out The "Ruffles" On The Mains*, gave a detailed rundown on the supply parameters and the short-term and long-term variations or events experienced. Let me recap.

The how

There are two ways or modes by which mains variations are conducted to the equipment; *common-mode* and *differential* mode.

Common-mode events are variations which occur on *both* lines at the same time, measured between active-neutral and ground.

Differential-mode events are variations which occur *between* active and neutral.

Just because the Australian mains system at the user level ties (or is supposed to tie) the neutral back to the ground doesn't mean to say common-mode variations are minimised or eliminated. They're not. And they can prove troublesome, even at relatively small amplitudes. However, differential-mode variations tend to predominate, both short term and long term.

The what

Problem events range from high frequency repetitive signals through transient events of a cycle or so's duration, to the complete loss of supply.

Transients are momentary, non-repetitive events lasting a half-cycle or less. They arise from load switching, electrical storms, welding, fault clearing, etc.

Hash is a high frequency signal that may be intermittent or continuous with frequency components ranging from 100 Hz to maybe 100 kHz. It may arise from motor commutation, switchmode power supplies, etc. Radio Frequency interference may be included under this heading, too.

Dropouts are momentary line faults where the line voltage drops to zero for periods up to a few cycles.

Sags and surges are brief over-voltage and under-voltage swings in the mains of at least 20% lasting from a cycle or so to several seconds. They often arise when heavy loads on the line are switched on and off.

Over/under voltage events are of longer duration than sags or surges, again represented by a change of 20% or more in the nominal line voltage. An undervoltage event is often termed a "brownout", sort of a half-baked blackout!

Blackout is complete loss of power, a term most are familiar with.

The effects of these events on electronic and computer equipment can range from momentary disruption through intermittent reliability problems to chaotic and destructive shutdown. Destructive here applies to loss of data or equipment function, not necessarily to physical damage of equipment.

Selecting a protection system

With some idea of the types, modes and causes of power line variations and their likely effects, how do you go about providing protection for the equipment and the systems it supports.

Your first consideration must be to assess the cost of problems arising from the events experienced, or likely to be experienced. The cost of protection should be assessed in relation to that,*not* in relation to the cost of the *equipment* being protected. It is a common mistake to compare the cost of power conditioners or standby supplies to the cost the electronic equipment or computer system under consideration, and this can be highly misleading. The significant factor is the cost of the function or system lost due to a power line disturbance.

Start at the simplest level. If you can determine that hash, transients and/or RF interference conducted via the mains lines are the source of problems you're experiencing, or may be contributing to your problems, then start looking at **filters** as your first port of call.

Filters can deal with common-mode *and* differential-mode noise of a short term nature. They cannot deal with longer term variations. There are filters and filters, to plagiarise an old expression. The problem may arise in another, entirely separate, item of equipment connected to the same mains circuit. A process of deductive investigation and elimination, item by item, using a plug-in filter can be used to identify the offending item. Applying the filter at the source in this case represents the most effective solution.

But such elegant solutions are not always available as the source of disruptive transients and hash is not always readily indentifiable or accessible.

In addition to the above, if you need to deal with events such as surges and sags, over and undervoltage, dropouts and the like, your next line of defence is the **power conditioner.** These contain a ferro-resonant constant voltage transformer (or CVT) and are designed to provide a regulated output voltage that remains within a specified "envelope" of performance with regard to line input fluctuations and output load variations.

A ferro-resonant CVT is very effective at eliminating differential-mode transients and hash. Generally, power conditioner manufacturers include further "lines of defence", such as earthed screens and input filtering, to minimise common-mode noise, too.

If your mains supply is, from experience, fairly stable and your only major concerns are short-term supply losses of a few seconds to some minutes duration, then the solution is to look at a **standby power supply** (SPS). Such units give allow your equipment to operate for a short period to permit data backup and/or orderly system shutdown. They comprise an inverter and a transfer switch and employ rechargeable batteries to supply energy during standby operation.

Standby power supplies operate in what is termed "off-line mode." That is, the incoming mains supply is filtered, the filtered output being used to power your equipment while ever the mains is operational. Should the mains voltage fall by greater than a given amount (usually 15-

20%), the SPS unit automatically switches to on-line mode and its internal inverter supplies the required "clean" ac power via the transfer switch.

When the incoming mains voltage once again rises above a specified limit, usually -10% of the nominal supply voltage, the SPS unit's transfer switch returns the load to ac main operation. The period of standby operation is only short, usually under twenty minutes. Transfer times are usually in the order of five to ten 5-10 milliseconds when switching from mains to standby, and less five milliseconds switching from standby to mains.

In some circumstances, the provision of a power conditioner and standby supply is called for to provide more complete protection. Some equipment is sensitive to the transfer switch action and the standby power supply will not provide the required solution to the problem. In this event, you need to look at the top level of protection and isolation.

If your mains supply is subject to the *full gamut* of disturbances — voltage sags and surges, overvoltage and undervoltage, transients, dropouts *and* blackout — your last port of call is the so-called **uninterruptible power supply.** These, generally known under the title of "UPS", provide complete isolation from the ac mains supply and offer *no break* operation in the event of mains supply failure.

A UPS is unlike an SPS in that it is *always* on line, providing continuous power to the load — your electronic equipment or computer system. Typically, an uninterruptible power supply consists of a rectifier and charger system, a rechargeable battery and an ac inverter. No transfer switch is involved.

The ac inverter in a UPS supplies the power to your equipment at all times. The incoming mains, while it's operational, supplies charge to the battery via the rectifier and charging system. The batteries continuously power the inverter. Since only dc is always present at the input to the inverter, either from the battery or rectifier, no transfer time is involved when the mains fails and the mains is entirely isolated from the equipment.

The rated operational period for a UPS is dependent on the battery capacity. When choosing a UPS, this period should be a major consideration and your choice based on either the expected time needed for an orderly system shutdown in the event of blackout or to span the expected or known blackout period, if only relatively short term (i.e: under several hours).

If a backup motor/generator system is involved or being considered, to provide long term operation for a system during prolonged mains failure (say up to seven or eight hours), then the UPS operational period required will be dependent on the changeover period of the motor/generator and the time it takes to stabilise the supply.

Typical UPS stand-alone operational periods range from 30 minutes to two hours. The time for full battery recovery is an important parameter when choosing a UPS for blackouts often follow periods of brownout when the UPS is operating partially, if not completely, from its internal battery. Recovery rate is usually expressed relative to discharge rate. A practical, fast recharge time would be one-eighth to one-twelfth the discharge period.

Battery choice for SPS and UPS systems is important. Of the two common types of rechargeable battery available — NiCad and lead-acid, the latter are most commonly used owing to their price and reliability. Recombination electrolyte (RE) lead-acid batteries are fully sealed and require no maintenance, as well as offering a long life in terms of charge/discharge cycles.

Ratings

Filters, power conditioners, standby power supplies and uninterruptible power supplies are all characterised by an output load rating quoted in volt-amps (VA). On a resistive load, VA merely means watts consumed, but as the equipment connected doesn't always appear resistive, the rating is given in VA.

Only 2500 VA may be drawn from a standard "general power outlet" (GPO), so any of the above-mentioned equipment designed to operate from a GPO will be rated accordingly.

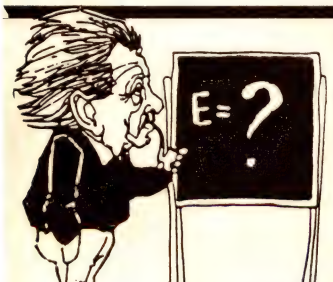
In-line filters are available rated from around 200 VA right up to 2500 VA. The smaller models may have only a single load socket, while the larger units generally have multiple outlets.

Likewise, in-line power conditioners designed to operate from a GPO are available rated from 100 VA to 2500 VA and may have single or multiple outlets. Power conditioners for operation from three-phase mains supplies are also obtainable in ratings up to hundreds of kVA.

Standby power supplies are generally meant for applications where only a single piece of equipment requires it, or a few items at most. Hence big systems are not often found. For the most part they are designed to operate from a GPO and the units available range in rating from a few hundred VA to 2000 VA.

On the other hand, uninterruptible power supplies obtainable are rated from a few hundred VA to 2500 VA for GPO operation, and up to 25 kVA for multi-phase supply operation. Sometimes, UPS systems are seen, using multiple units and having a total rating that may be as high as 4800 kVA. You see them used to keep large mainframe computers on the air.

We would like to thank NCR and Sola for supplying information used in the compilation of this feature.



If your Transceiver uses Micro Logic Components, then we recommend

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PIF 3-3A	3 AMPS	2 STAGE	+ E.L.C.
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WS25M/R

Data Sheet

National Semiconductor

LM833 Dual Audio Operational Amplifier

General Description

The LM833 and LM833A are dual general purpose operational amplifiers designed with particular emphasis on performance in audio systems.

These dual amplifier ICs utilize new circuit and processing techniques to deliver low noise, high speed and wide bandwidth without increasing external components or decreasing stability. The LM833 and LM833A are internally compensated for all closed loop gains and are therefore optimized for all preamp and high level stages in PCM and HiFi systems.

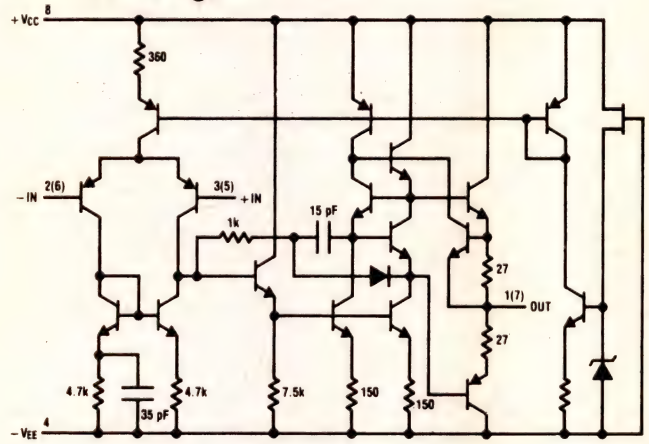
The LM833 and LM833A are pin for pin compatible with industry standard dual operational amplifiers.

The LM833A guarantees low noise for noise critical applications by 100% noise testing.

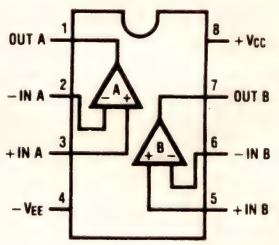
Features

■ Wide dynamic range	> 140 dB
■ Low input noise voltage	4.5 nV/$\sqrt{Hz}$
■ High slew rate	7 V/μs (typ) 5 V/μs (min)
■ High gain bandwidth product	15 MHz (typ) 10 MHz (min)
■ Wide power bandwidth	120 kHz
■ Low distortion	0.002%
■ Low offset voltage	0.3 mV
■ Large phase margin	60°

Schematic Diagram (1/2 LM833)

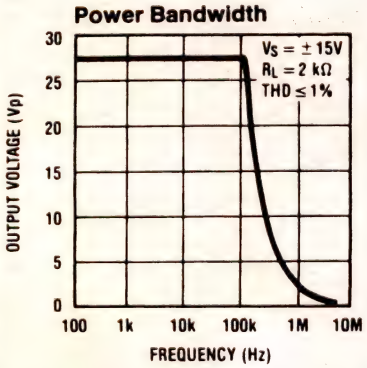


Connection Diagram

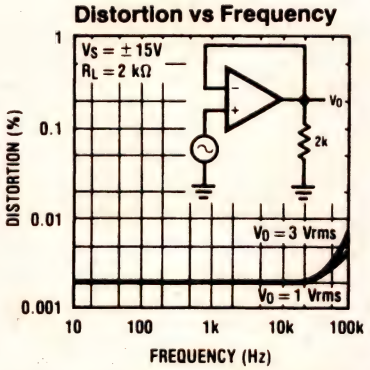


Typical Performance Characteristics

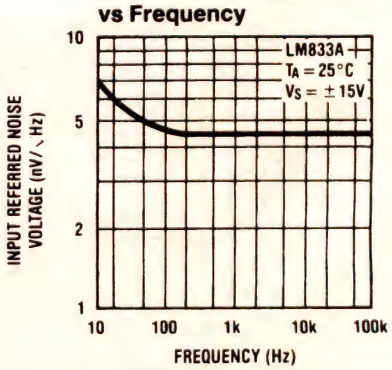
Power Bandwidth



Distortion vs Frequency



Spot Noise Voltage vs Frequency



Absolute Maximum Ratings

Supply Voltage	V_{CC}/V_{EE}	±18V	Power Dissipation (Note 2)	P_D	500 mW
Differential Input Voltage (Note 1)	V_{ID}	±30V	Operating Temperature Range	T_{OPR}	−40 ~ 85°C
Input Voltage Range (Note 1)	V_{IC}	±15V	Storage Temperature Range	T_{STG}	−60 ~ 150°C

DC Electrical Characteristics (T_A = 25°C, V_S = ±15V)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
V_{OS}	Input Offset Voltage	R_S = 10Ω		0.3	5	mV
I_{OS}	Input Offset Current			10	200	nA
I_B	Input Bias Current			500	1000	nA
A_V	Voltage Gain	R_L = 2 kΩ, V_O = ±10V	90	110		dB
V_{OM}	Output Voltage Swing	R_L = 10 kΩ R_L = 2 kΩ	±12 ±10	±13.5 ±13.4		V V
V_{CM}	Input Common-Mode Range		±12	±14.0		V
CMRR	Common-Mode Rejection Ratio	V_{IN} = ±12V	80	100		dB
PSRR	Power Supply Rejection Ratio	V_S = 15~5V, −15~−5V	80	100		dB
I_Q	Supply Current	V_O = 0V, Both Amps		5	8	mA

AC Electrical Characteristics (T_A = 25°C, V_S = ±15V, R_L = 2 kΩ)

Symbol	Parameter	Conditions	Min	Typ	Max	Units
SR	Slew Rate	R_L = 2 kΩ	5	7		V/μs
GBWP	Gain Bandwidth Product	f = 100 kHz	10	15		MHz
e_{n1}	LM833A Equivalent Input	RIAA, R_S = 470Ω		0.5	0.8	μV
	Noise Voltage (Note 3)					

Design Electrical Characteristics (T_A = 25°C, V_S = ±15V)

The following parameters are not tested or guaranteed.

Symbol	Parameter	Conditions	Typ	Units
$\Delta V_{OS}/\Delta T$	Average Temperature Coefficient of Input Offset Voltage		2	μV/°C
THD	Distortion	R_L = 2 kΩ, f = 20~20 kHz V_{OUT} = 3 Vrms, A_V = 1	0.002	%
e_n 2	Input Referred Noise Voltage 2	R_S = 100Ω, JISA	0.5	μV
e_n 3	Input Referred Noise Voltage 3	R_S = 100Ω, f = 1 kHz	4.5	nV/√Hz
i_n	Input Referred Noise Current	f = 1 kHz	0.7	pA/√Hz
PBW	Power Bandwidth	V_O = 27 V_{pp}, R_L = 2 kΩ, THD ≤ 1%	120	kHz
f_U	Unity Gain Frequency	Open Loop	9	MHz
ϕ_M	Phase Margin	Open Loop	60	deg
	Input Referred Cross Talk	f = 20~20 kHz	−120	dB

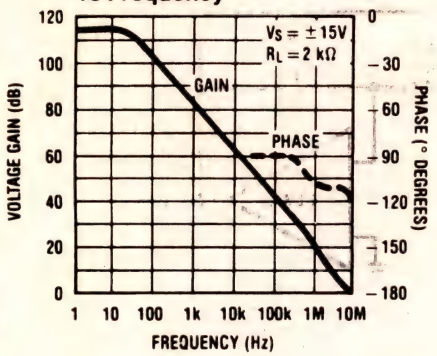
Note 1: If supply voltage is less than 15V, it is equal to supply voltage.

Note 2: This is the permissible value at T_A ≤ 85°C.

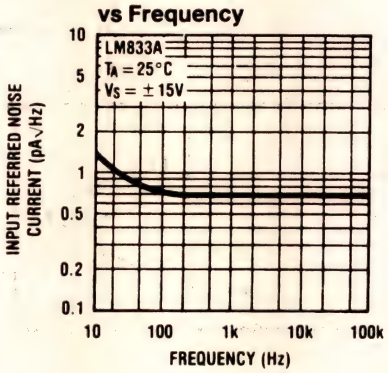
Note 3: Only the LM833A is noise tested and guaranteed.
See "Noise Measurement Circuit" for test conditions.

Typical Performance Characteristics (Continued)

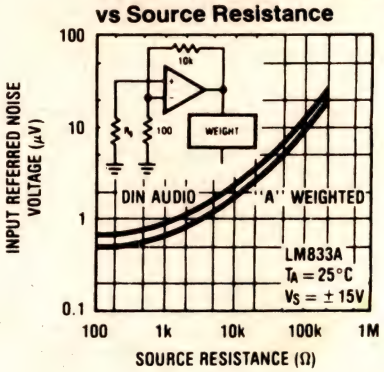
Voltage Gain & Phase vs Frequency



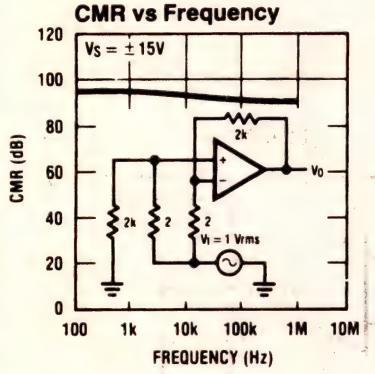
Spot Noise Current vs Frequency



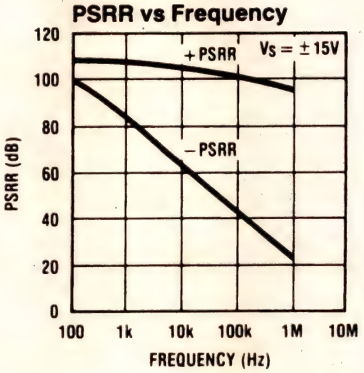
Input Referred Noise Voltage vs Source Resistance



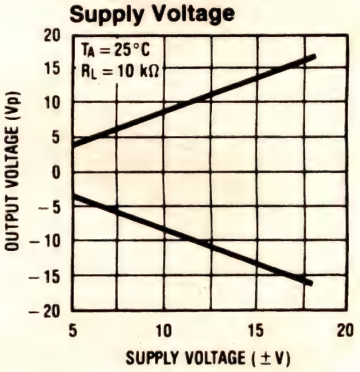
CMR vs Frequency



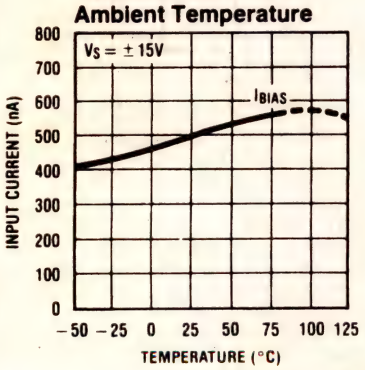
PSRR vs Frequency



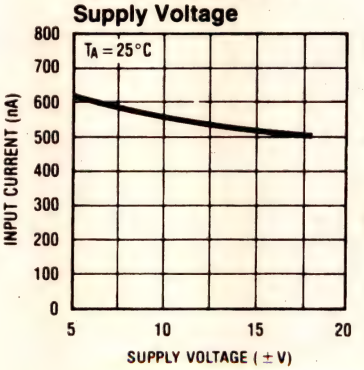
Maximum Output Voltage vs Supply Voltage



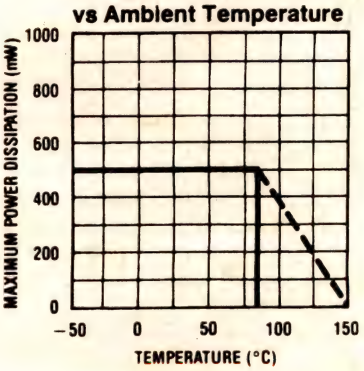
Input Bias Current vs Ambient Temperature



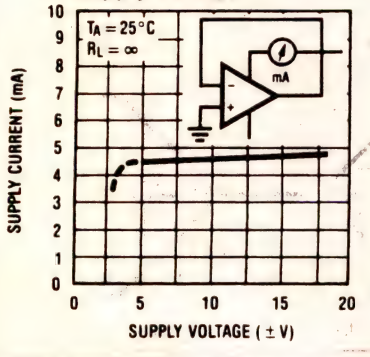
Input Bias Current vs Supply Voltage



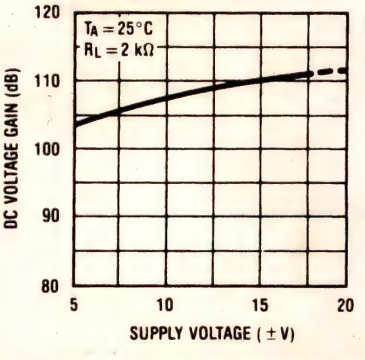
Maximum Power Dissipation vs Ambient Temperature



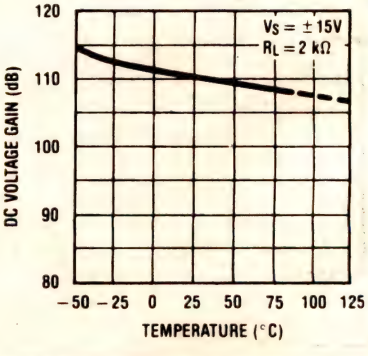
Supply Current vs Supply Voltage



DC Voltage Gain vs Supply Voltage

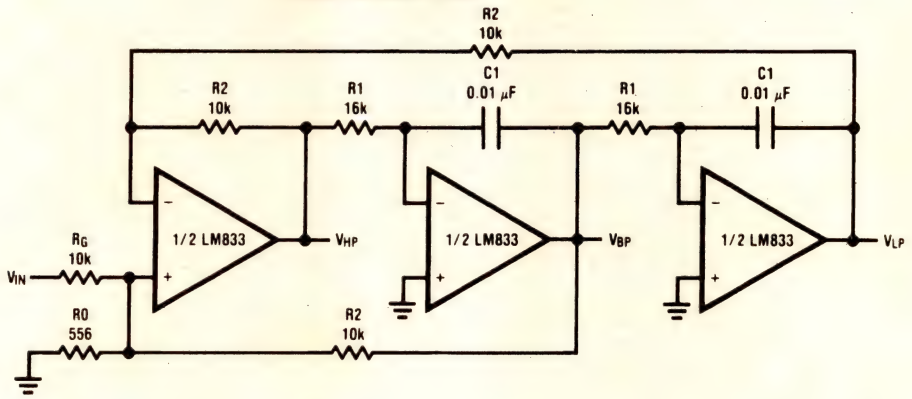


DC Voltage Gain vs Ambient Temperature



Typical Applications

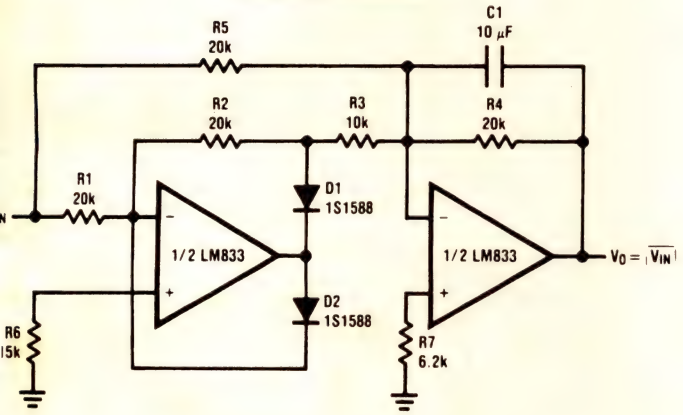
State Variable Filter



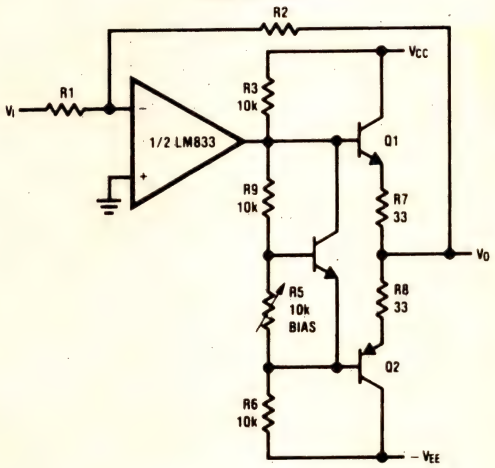
$$f_0 = \frac{1}{2\pi C1R1}, Q = \frac{1}{2}\left(1 + \frac{R2}{RQ} + \frac{R2}{RQ}\right), A_{BP} = QA_{LP} = QA_{LH} = \frac{R2}{RG}$$

Illustration is f_0 = 1 kHz, Q = 10, A_{BP} = 1

AC/DC Converter

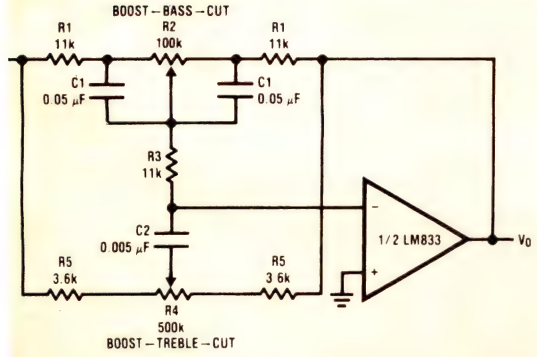


Line Driver



We would like to acknowledge the cooperation of Semtech Pty Ltd and National Semiconductor Australia for providing the information and permission to publish the details presented in this data sheet.

Tone Control



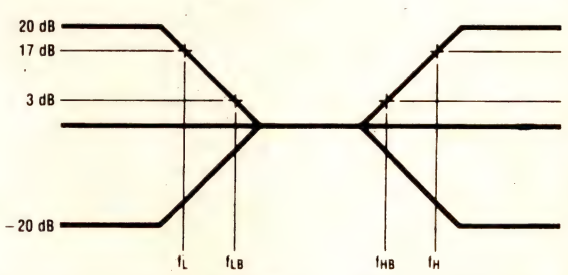
$$f_L = \frac{1}{2\pi R2C1}, f_{LB} = \frac{1}{2\pi R1C1}$$

$$f_H = \frac{1}{2\pi R5C2}, f_{HB} = \frac{1}{2\pi(R1 + 2R3)C2}$$

Illustration is:

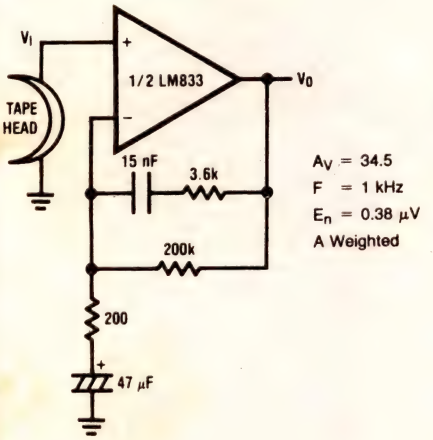
f_L = 32 Hz, f_{LB} = 320 Hz

f_H = 11 kHz, f_{HB} = 1.1 kHz



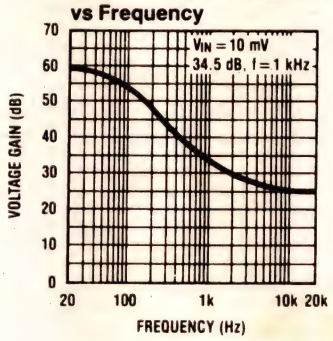
Typical Application (Continued)

NAB Preamp

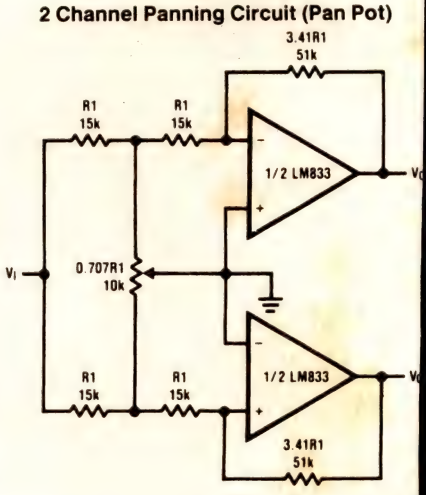


A_V = 34.5
F = 1 kHz
E_n = 0.38 μV
A Weighted

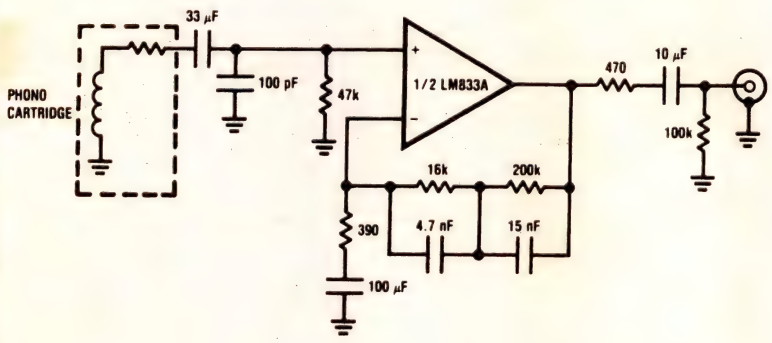
NAB Preamp Voltage Gain vs Frequency



2 Channel Panning Circuit (Pan Pot)



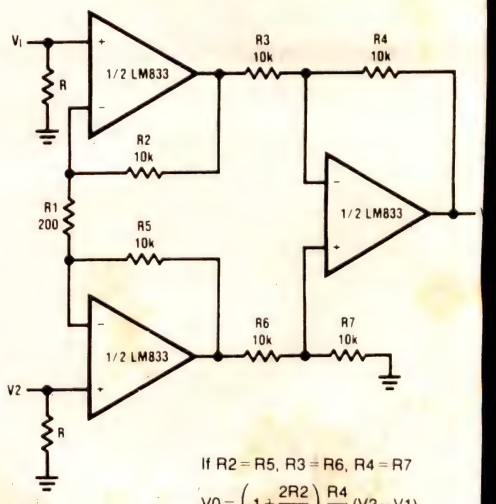
RIAA Preamp



A_v = 35 dB
E_n = 0.33 μV
S/N = 90 dB

f = 1 kHz
A Weighted
A Weighted, V_{IN} = 10 mV
● f = 1 kHz

Balanced Input Mic Amp

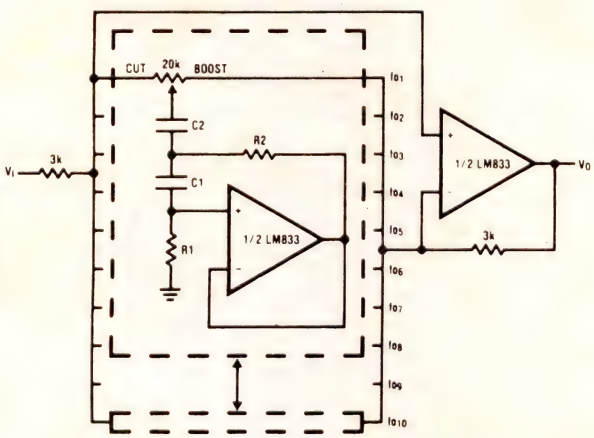


If R2 = R5, R3 = R6, R4 = R7

$$V0 = \left(1 + \frac{2R2}{R1}\right)\frac{R4}{R3}(V2 - V1)$$

Illustration is:
V0 = 101(V2 − V1)

10 Band Graphic Equalizer



fo(Hz)	C_1	C_2	R_1	R_2
32	0.12μF	4.7μF	75kΩ	500Ω
64	0.056μF	3.3μF	68kΩ	510Ω
125	0.033μF	1.5μF	62kΩ	510Ω
250	0.015μF	0.82μF	68kΩ	470Ω
500	8200pF	0.39μF	62kΩ	470Ω
1k	3900pF	0.22μF	68kΩ	470Ω
2k	2000pF	0.1μF	68kΩ	470Ω
4k	1100pF	0.056μF	62kΩ	470Ω
8k	510pF	0.022μF	68kΩ	510Ω
16k	330pF	0.012μF	51kΩ	510Ω

At volume of change = ±12dB
Q = 1.7

Reference: "AUDIO/RADIO HANDBOOK", National Semiconductor, 1980, Page 2-

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It isn't really funny. It's sad, if anything.

But to explain. Roger, from his endless resources, planned to print the circuit of a pre-World War II valve radio in the Vintage Restorations section of this issue.

Looking at it brought back the nostalgic type of fit I always get when I see a Model T Ford in a vintage car parade or something. Another of life's ambitions, formed when I was a child, to pass me by; the ambition to own one of those high, square-box Model T's. I've never even got to drive one, let alone own one. The nearest I ever got was to own a 1928 Austin Seven, which used to purr along the roads like a sewing machine. Except that the brakes never worked terribly well...

Always having to be satisfied with less. Such is life.

But back to Roger's valve radio.

It was so ancient that even I had trouble working out how it had worked...although I dimly remember studying "anode bend" and "power anode" detectors. After all, I began with my first receiver having a grid leak detector but then made the quantum leap to the diode detector. That was living dangerously, in those pre-IC days!

Among the memories are one of my brother-in-law radio serviceman and how we used to take old valves down the riverbed and shoot them with a .22. My father — a keen kitchen gardener — found a better use for them. He used to tie them with string to stakes driven into the ground around his peas, at an angle of 45°. The glassy, silvery reflective valves, moving in a slight wind, and clonking together in a higher one, was enough to put off any pea-seeking bird.

That's another thing you can't do with transistors, either, although I'm not here to rubbish solid-state. I did once make a gavel for an electronics society and mounted a TO3 package on each hammer face. If the chairman ever got excited — like judges do in Hollywood films when they try and stop the uproar in court by pounding away — those TO3s would have had it hard.

And that's something you can't do with valves!

Back again to Roger's valve radio item. It was of the era, pre-war, when there were about 50 valves listed in the old RCA valve manual and if you were worth your salt you knew the pin connections and parameters of all of those funny glass bottles with lights in them by heart.

Then by the imminence of the end of the valve era, in the late 1950s, international valve books were listing about 15 000. In much less time, transistor handbooks were out of control like an undecoupled stage feeding back, and there were more solid-state devices listed than there ever were valves.

But after all these ramblings it's time I got back to the point. Which, as said in the introduction to all this burble, is really sad.

It's about the way that every day we read about technology putting people out of work. Honest, decent people who made the great mistake of believing politicians when they said if you voted for them, you wouldn't have to think any more. Just go to Grand Finals or watch Dynasty on TV and everything would be all right.

Well, they don't get any sympathy from me. Any time I hear someone whingeing about getting displaced by a robot, I remember how 20 or 25 years ago we tried to say that electronics was going to revolutionise work. Boring, monotonous, repetitive work to be automated...Much more interesting jobs to be created in service industries.

Of course, no-one wanted to know. Polies interested only in what would happen in the next three years, before the next election. Trade unions interested only in the next strike, so they could sell their members the idea they were doing something for them. Dumb journalists who didn't know what it was all about anyway and just wanted to chase fire engines, as being more spectacular.

And then: Shock! Horror! "The factory's closing next week, why didn't 'they' do something about it?"

So I am always interested to know what sort of radio those displaced by new technology have at home. Is it, I wonder, a $12 distortion generator? Or a beaut 100 W per channel hi-fi? Of course it is! (Solid-state, I mean.)

The day that I, as one of the Boat People from the era of FETs with LEDs, find someone who believed enough in keeping jobs for locals, even at the inconvenience of fragile, expensive, space-consuming valves, then I am going to feel sincerely sorry for him and even get rid of one of Bob Hawke's atrocious $2 coins in his begging bowl.

But as one who had to adjust to completely new technology, I don't give you a drop of sympathy if you've lost your job to new technology but all the entertainment electronics in your home is solid-state.

He who laughs longest laughs loudest.

(Psst! Spare a copper for an old valve radio technician, guv? Or 50c for a cup of pa?)

Ben Furby

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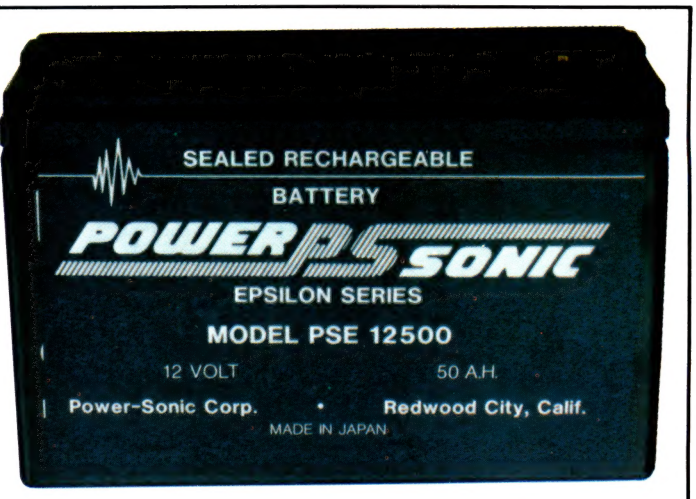

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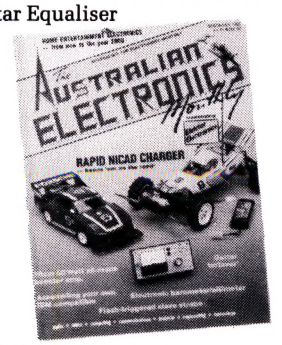
EFG7515 Modem IC Data Sheet
Guitar Equaliser



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